1999 Periodic Ozone Emissions Inventory

for the

Maricopa County, Arizona, Nonattainment Area

November 2001
FINAL Document

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

This inventory was constructed based on federal requirements stated in the Clean Air Act Amendments of 1990 (CAAA). Title I of the CAAA contains provisions on the required development of ozone and carbon monoxide emission inventories for designated areas that failed to meet the National Ambient Air Quality Standards (NAAQS) for ozone and carbon monoxide. Maricopa County is an ozone nonattainment area classified as serious in 1997. It formerly was a moderate area with a design value of 0.141 ppm.

Maricopa County Environmental Services Department (MCESD) prepared this 1999 ozone periodic inventory for three ozone precursors: volatile organic compounds (VOC), carbon monoxide (CO), and oxides of nitrogen (NO_x). The daily ozone season emissions cover the period from July through September 1999. The sources of emissions are categorized in five areas of emphasis: 1) Point Sources; 2) Area Sources; 3) Nonroad Mobile Sources; 4) Onroad Mobile Sources; and 5) Biogenic Sources. Figures ES-1, ES-2, and ES-3 present the data in three pie charts, one for each pollutant. Table 1-13 in Chapter 1 provides an overview of annual ozone precursor emissions by source type.

Stationary point sources (addressed in Section 2) nclude those sources that emit ten tons or more per year of VOC, as well as those that emit 100 tons or more per year of VOC, CO, or NO_x and are located within 25 miles of the nonattainment area. Those facilities that emitted greater than 5 tons in 1999, and were in past periodic emission inventories, were also included. A total of 188 point sources were identified in the ozone inventory: 183 point sources are within the nonattainment area and 5 point sources are within 25 miles of the nonattainment area. Individual stationary point sources account for 6.81 percent of the VOC, 7.03 percent of the NO_x, and 0.56 percent of the total CO emissions for ozone season day. These percentages equate to 21.96 tons of VOC, 21.06 tons of NO_x and 6.55 tons of CO per ozone season day.

Area sources (Section 3) are those stationary sources in the nonattainment area that are too small to be considered point sources but are too many to be discounted. They included petroleum storage and transport, combustion sources, industrial processes, solvent utilization and waste disposal sources. Area sources account for 28.19 percent of the VOC, 7.55 percent of the NO_x, and 3.96 percent of the total CO emissions for ozone season day. This equates to 91.01 tons of VOC, 22.63 tons of NO_x and 46.42 tons of CO per ozone season day.

Nonroad mobile sources (Section 4) include aircraft, locomotives, diesel equipment, 4-stroke gasoline equipment, and 2-stroke gasoline equipment in the nonattainment area. Nonroad mobile sources account for 21.93 percent of the VOC emissions, 32.98 percent of the NO_x emissions, and 41.36 percent of the CO emissions out of the total ozone season day emissions. This is an estimated 70.79 tons of VOC, 98.85 tons of NO_x and 484.60 tons of CO per ozone season day.

Onroad mobile sources (Section 5) were calculated by the Maricopa Association of Governments (MAG). Emission factors for seven vehicle type categories are calculated using MOBILE 5a, the latest in a series of models developed by the EPA for the purposes of estimating motor vehicle emission factors. Onroad mobile sources account for 28.01 percent of the VOC emissions, 49.10 percent of the NO_x emissions, and 54.12 percent of the CO emissions of the total ozone season day emissions. This is an estimated 90.44 tons of VOC, 147.14 tons of NO_x and 634.11 tons of CO per ozone season day.

Biogenic source emissions (emissions from living vegetation; Section 6) are calculated using the computer model MAG-BEIS2. Biogenic sources account for 15.07 percent of the VOC emissions and 3.34 percent of the NO_x emissions out of the total ozone season day emissions. This is an estimated 48.66 tons of VOC and 10.02 tons of NO_x daily.

The overall inventory is structured to include an overview of the inventory process, tables of summary data, documentation of data, and quality assurance steps taken. Each section of the inventory is a discrete analysis, which includes an introduction, scope, methodology and approach for estimating emissions, subsections with example calculations, and a summary.

Figure ES-1. 1999 Ozone Season: Daily VOC Emissions by Category (tons/day)

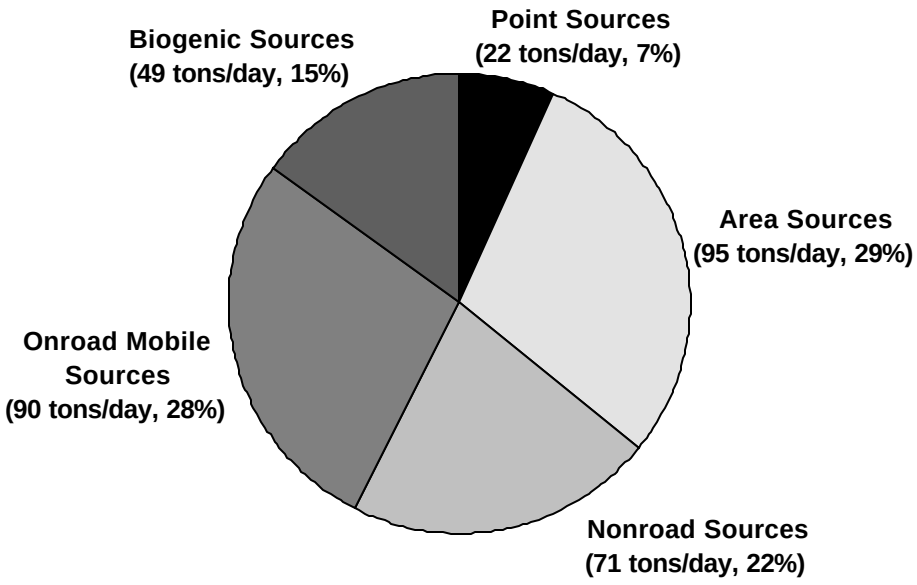


Figure ES-2. 1999 Ozone Season: Daily NO_x Emissions by Category (tons/day)

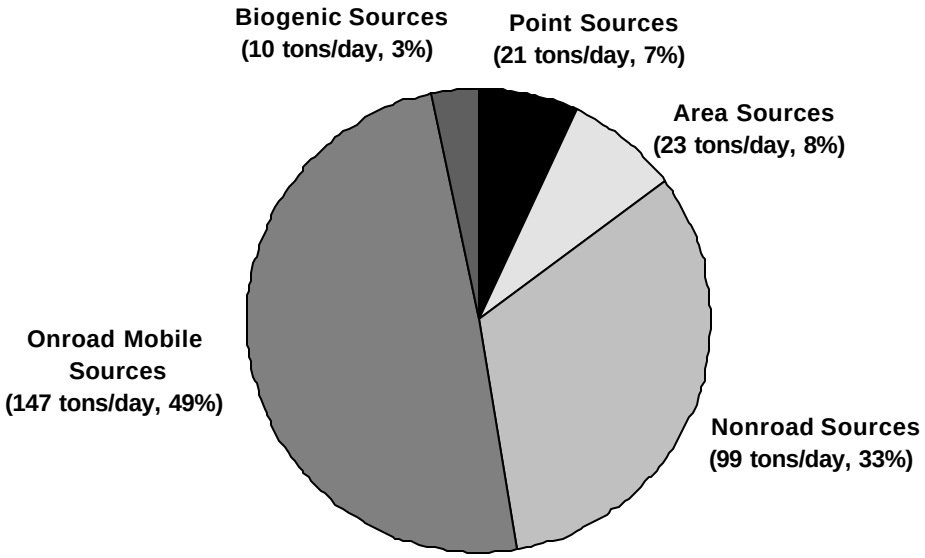
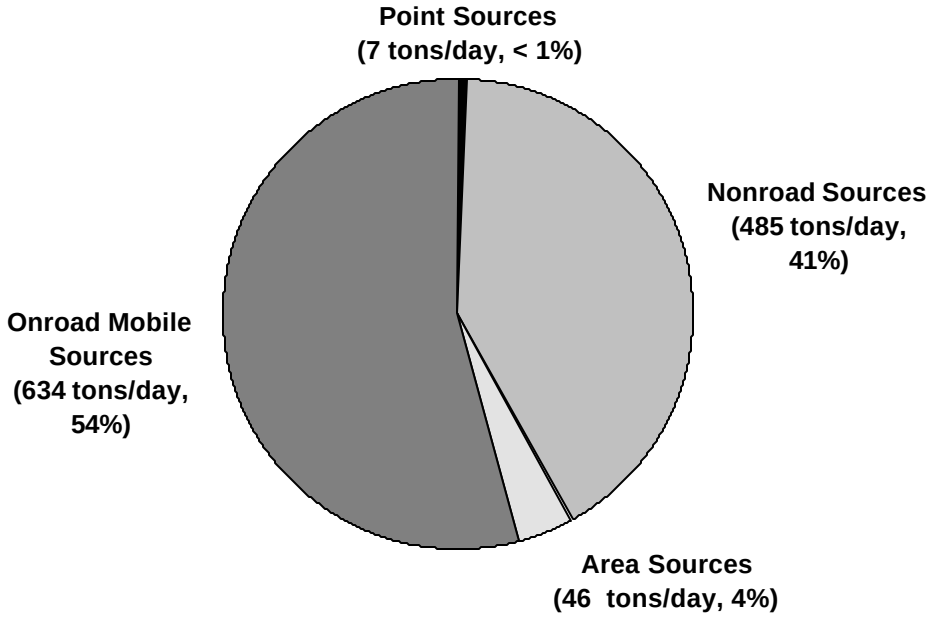


Figure ES-3. 1999 Ozone Season: Daily CO Emissions by Category (tons/day)



SECTION 1. BACKGROUND AND EMISSIONS SUMMARY

1.1 Background

1.1.1 Type of Inventory, Pollutants, and Source Categories

This document presents the 1999 ozone periodic emissions inventory for the Maricopa County ozone nonattainment area. The inventory addresses VOC, NO_x, and CO emissions from stationary point, area, nonroad mobile, onroad mobile sources, and biogenic sources. This was constructed based on federal requirements stated in the Clean Air Act Amendments of 1990 (CAAA). Title I of the CAAA contains provisions on the required development of ozone and carbon monoxide emission inventories for designated areas that failed to meet the National Ambient Air Quality Standards (NAAQS) for ozone and carbon monoxide. The Maricopa County ozone nonattainment area is classified as serious.

Season day emissions from the Maricopa County nonattainment area for the 1999 base year are calculated for all categories. The three-month peak ozone season for the Maricopa County nonattainment area has been determined to be July 1 through September 30 based on the ozone exceedances from 1981 through 1991 (MCESD, 1993); therefore this inventory covers July through September, 1999. Although only the past three to four years is required when determining the ozone season (EPA, 1991), this ten-year range of data were used with the same result and to be consistent with the 1990 base year. The number of ozone exceedances from 1981 through 1991 is shown below.

Table 1-1. Ozone Exceedances for the Maricopa County Nonattainment Area, by Month (1981–1991)

Month	Number of Ozone Exceedances, 1981–1991
May	1
June	6
July	7
August	16
September	15
October	2

Annual 1999 emissions are calculated for all sources categories except onroad mobile and biogenics, for which only daily emissions were calculated. Table 1-2 shows a list of all major categories included in this ozone inventory.

The major emission source categories are addressed by section. Section 2 addresses the individual stationary point sources. A list of all large point sources and their emissions, along with sample calculations and summary tables is contained in Section 2. Supporting documentation can be found in Section 2 Appendices. Section 3 provides a complete explanation of each area source category, and describes in detail the methods used to calculate emissions. Supporting documentation for area sources can be found in Section 3 Appendices. Section 4 addresses the nonroad mobile source inventory. Aircraft activity, locomotives, and nonroad equipment are included in this section. The FAA Aircraft Engine Emissions Database (FAEED) computer inputs, locomotive emissions information, and nonroad equipment calculations are shown in Section 4 Appendices. Section 5 describes the derivation of the onroad mobile source inventory. An explanation of the MOBILE5a computer model's inputs and outputs can be found in the Appendices for Section 5. Section 6 shows estimated biogenic emissions and the process of obtaining these emission estimates. Section 7 provides a description of the quality assurance program used to ensure that the

inventory follows EPA specifications. It should be noted that the values listed in this inventory might not total exactly due to rounding differences while calculating emissions for various sections.

Table 1-2. Major Emission Source Categories

Category	Sections
Fuel Combustion: Industrial	Sections 2 and 3
Fuel Combustion: Commercial/ Institutional	Sections 2 and 3
Chemical and Allied Product Manufacturing	Sections 2 and 3
Metals Processing	Section 2
Other Industrial Processes	Sections 2 and 3
Solvent Utilization	Sections 2 and 3
Storage and Transport	Sections 2 and 3
Waste Disposal and Recycling	Sections 2 and 3
Highway Vehicles	Section 5
Off Highway	Section 4
Natural Sources	Section 6
Miscellaneous	Sections 2 and 3

1.1.2 Geographic Area

The Maricopa County nonattainment area is approximately 1,962 square miles or approximately 20 percent of the Maricopa County land area. This area was designated as a "moderate" (design value of 0.141 ppm) non-attainment area for ozone by the EPA (US Government, 1991), and redesignated as “serious” in 1997. The geographic boundaries of the nonattainment area are shown in Figure 1-1.

1.1.3 Demographic Profile

A demographic profile of the Maricopa County Ozone nonattainment area was provided by the Maricopa Association of Governments (MAG) and is included as Appendix 1–1. This demographic profile was derived from the MAG update of the population and socioeconomic database for Maricopa County (MAG, 2000).

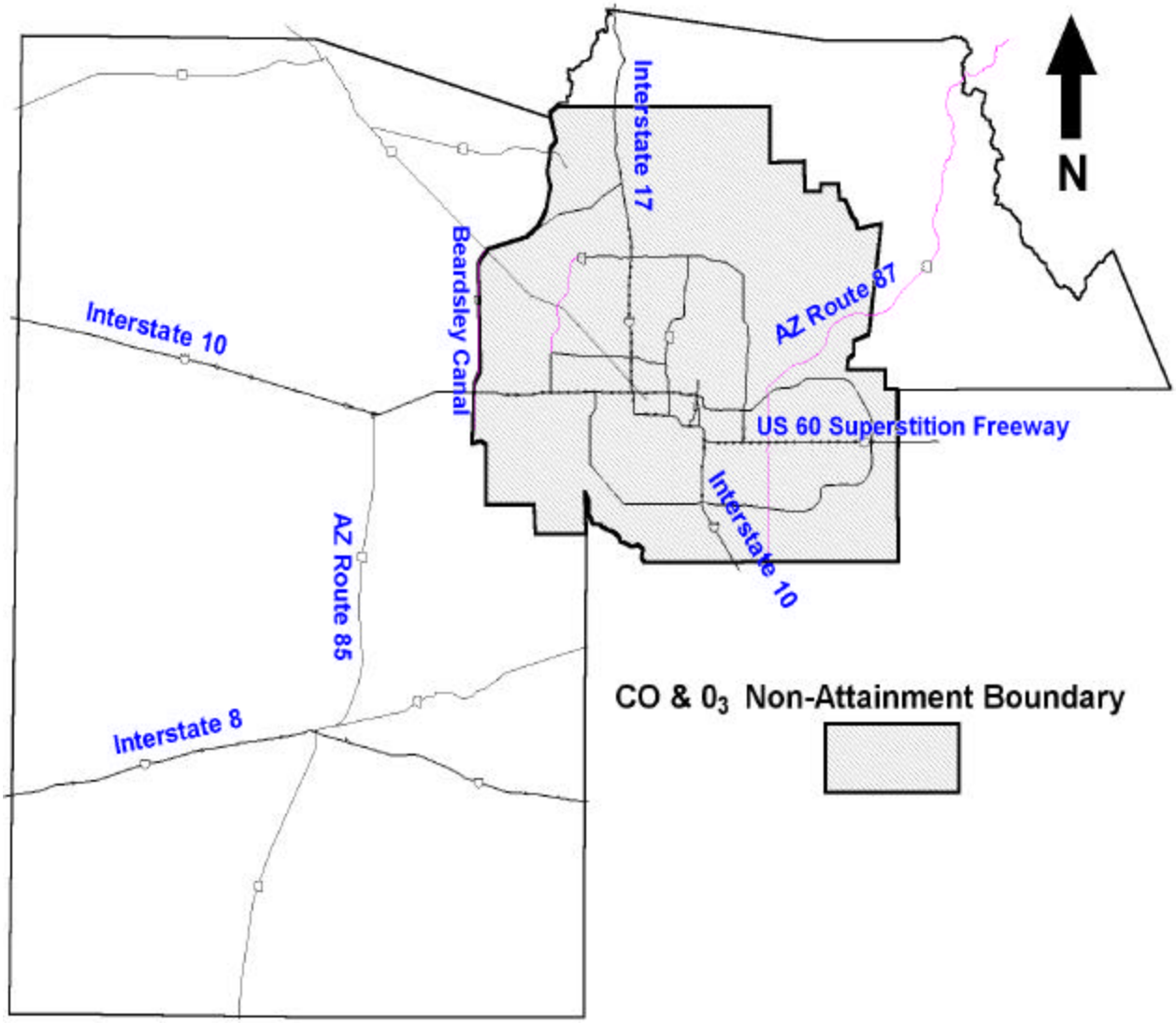
The square miles within the nonattainment area boundary were calculated by digitizing the boundary and summing the area within the boundary using ArcInfo GIS software. There are 1,962 square miles within the Ozone nonattainment area boundary. Definitions of the terms and a breakdown of population, households, and employment within the nonattainment area boundary are found in Table 1–3.

Table 1-3. 1999 Demographic Profile of the Ozone Nonattainment Area

Total Population	2,957,147
Total Households	1,124,469
Total Employment:	1,414,767
– Industrial Employment	313,613
– Office Employment	396,106
– Retail Employment	325,133
– Public Employment	189,263
– Other Employment	190,652

- Total population is the sum of resident population in households, resident population in group quarters, transient population, and seasonal population.
- Total households are the sum of resident, group quarter, transient, and seasonal housing units.

Figure 1-1. Arizona Air Quality Attainment Designations for Ozone



- Industrial employment includes those jobs in the manufacturing and wholesale trade categories.
- Office employment includes finance, consulting, real estate, and insurance. The medical industry is not included.
- Retail employment is associated with the retail trade sector of the economy. Examples include department store, grocery store, and restaurant workers.
- Public employment includes police, military, museums, schools, government, and libraries.
- Other employment is all employment not included in the above categories. Examples include medical, postal, transportation, utilities, and communication.

Further details can be found in Appendix 1-1.

1.1.4 Agencies/Groups Responsible for the Emissions Inventory

The agency with direct responsibility for preparing and submitting the Maricopa County nonattainment area 1999 Ozone Periodic Emission Inventory is the Maricopa County Environmental Services Department (MCESD). Stationary point and area source emissions estimates, as well as calculations for aircraft, locomotive, and nonroad equipment emissions were prepared by MCESD. Nonroad equipment emissions, except aircraft and locomotives, were adapted using the EPA NEVES study from 1990, with adjustments to this study made by MCESD. The Maricopa Association of Governments (MAG) prepared the onroad mobile source and biogenic source emissions. Quality assurance activities are described in Section 7. All preparation and quality control contacts for all categories above are listed in Table 1-4.

Table 1-4. Maricopa County 1999 Periodic Year Ozone Emissions Inventory Contacts

Task / Section:	Name and Affiliation	Phone
Emission Inventory Preparation:		
Stationary Point, Area, and Nonroad Mobile Sources	Renee Kongshaug, MCESD	(602) 506-4057
	Bob Downing, MCESD	(602) 506-6790
Transportation Data, Biogenic Sources	Ruey-in Chiou, MAG	(602) 254-6300
Onroad Mobile Sources and Modeling	Roger Roy, MAG	(602) 254-6300
Modeling	Peter Hyde, ADEQ	(602) 207-7642
Quality Assurance / Quality Control:		
Stationary Point, Area, and Nonroad Mobile Sources	Renee Kongshaug, MCESD	(602) 506-4057
Transportation Data/Onroad Mobile Sources and Modeling	Ruey-in Chiou, MAG	(602) 254-6300
External QA	Randy Sedlacek, ADEQ	(602) 207-2300

1.2 Emissions Summary

The sources of emissions found in this inventory can be classified into five broad categories: 1) Stationary Point; 2) Area; 3) Nonroad Mobile; 4) Onroad Mobile; and 5) Biogenic sources. Collectively all five sources are estimated to contribute 322.86 tons of VOC, 299.70 tons of NO_x, and 1,171.68 tons of CO per ozone season day. A complete description of these sources and the corresponding methodologies used to calculate emissions for 1999 are included in Sections 2 through 6. A summary of this inventory is provided below.

1.2.1 Stationary Point Sources

The stationary point category includes those stationary sources that emit a significant amount of pollution into the air such as power plants, large manufacturing facilities, and petroleum product storage and transfer facilities. As directed by EPA procedures, this 1999 ozone periodic emission inventory includes point sources that are outside the nonattainment area but within 25 miles of the nonattainment area and that meet the criteria. The following

estimates include the five point sources that fall into this category. There were a total of 188 point sources addressed in Section 2.

Emissions from stationary point source during a typical ozone season day are estimated to be: 21.96 tons of VOC, 21.06 tons of NO_x, and 6.55 tons of CO per day. The stationary point source category contributes 6.80 percent of the total VOC emissions, 7.03 percent of the total NO_x emissions, and 0.56 percent of the total CO emissions for ozone season day.

Table 1-5 shows a breakdown of the stationary point sources into various categories. Table 1-6 compares the stationary point source contributions within the metropolitan Phoenix nonattainment area to the contributions from other sources within Maricopa County but outside the nonattainment area.

Table 1-5. Ozone Precursors Emitted from Point Source Categories Included in the 1999 Ozone Inventory

Level II Tier Code	Category	VOC tons/yr	VOC tons/day	NO_x tons/yr	NO_x tons/day	CO tons/yr	CO tons/day
	Electric Utilities – Fuel Combustion:						
0102	Fuel Oil	0.21	0.00	12.79	0.07	1.43	0.01
0103	Natural Gas	44.82	0.17	1,519.20	5.70	531.72	1.97
0105	Internal Combustion	27.26	0.10	3,096.99	12.39	515.15	2.26
	Subtotal	**72.29**	**0.27**	**4,628.98**	**18.17**	**1,048.29**	**4.24**
	Industrial – Fuel Combustion:						
0202	Fuel Oil	0.18	0.00	11.83	0.07	2.74	0.01
0203	Natural Gas	13.06	0.04	231.48	0.69	230.76	0.68
0204	Other Fuel	8.00	0.02	71.73	0.20	33.42	0.09
0205	Internal Combustion	26.33	0.09	231.66	0.94	85.45	0.29
	Subtotal	**47.56**	**0.16**	**546.70**	**1.90**	**352.38**	**1.08**
	Other Fuel Combustion – Commercial/Institutional:						
0302	Fuel Oil	1.13	0.00	44.23	0.12	11.79	0.03
0303	Natural Gas	14.66	0.04	80.23	0.27	43.31	0.12
0304	Miscellaneous Fuel Combustion	10.37	0.04	7.57	0.02	8.24	0.03
	Subtotal	**26.15**	**0.09**	**132.03**	**0.42**	**63.35**	**0.18**
	Chemical & Allied Manufacturing:						
0403	Polymer & Resin	124.96	0.40	1.29	0.01	1.08	0.00
0405	Paints, Varnishes, Lacquers, Enamels	51.52	0.22				
0406	Pharmaceuticals	7.92	0.03				
	Subtotal	**184.40**	**0.66**	**1.29**	**0.01**	**1.08**	**0.00**
	Metals Processing:						
0501	Non-Ferrous Processing	3.12	0.01	18.66	0.05	96.97	0.27
0502	Ferrous Metals Processing	48.41	0.18	2.68	0.01	42.36	0.16
0503	Other	10.29	0.04				
	Subtotal	**61.82**	**0.23**	**21.34**	**0.06**	**139.33**	**0.43**

Table 1-5 (cont'd). Ozone Precursors Emitted from Point Source Categories Included in the 1999 Ozone Inventory

Level II Tier Code	Category	VOC tons/yr	VOC tons/day	NO_x tons/yr	NO_x tons/day	CO tons/yr	CO tons/day
	Other Industrial Processes:						
0701	Agriculture, Food & Kindred Products	107.44	0.39				
0702	Textiles, Leather & Apparel Products	3.27	0.01				
0703	Wood, Pulp, Paper, & Pub. Products	20.07	0.09				
0704	Rubber & Misc. Plastic Products	375.45	1.30				
0705	Mineral Products	32.74	0.13	36.87	0.13	125.99	0.41
0707	Electronic Equipment	51.60	0.17				
0710	Miscellaneous Industrial Processes	472.35	1.57	0.01	0.00	0.27	0.00
	Subtotal	**1,062.92**	**3.66**	**36.88**	**0.13**	**126.26**	**0.42**
	Solvent Utilization:						
0801	Degreasing	249.21	0.81				
0802	Graphic Arts	267.34	0.95				
0804	Surface Coating	3,364.05	12.49	33.82	0.11	12.13	0.04
0805	Other Industrial	285.38	1.75	0.61	0.00	0.51	0.00
0806	Non-Industrial	3.42	0.01				
	Subtotal	**4,169.41**	**16.02**	**34.43**	**0.11**	**12.64**	**0.04**
	Storage & Transport:						
0901	Bulk Terminals & Plants	187.59	0.56				
0902	Petroleum & Petroleum Products Storage	30.04	0.09				
0904	Service Stations: Stage I	0.71	0.00				
0907	Organic Chemical Storage	3.01	0.01				
0911	Bulk Materials Storage	9.35	0.04	34.55	0.16	14.02	0.06
	Subtotal	**230.71**	**0.71**	**34.55**	**0.16**	**14.02**	**0.06**
	Waste Disposal & Recycling:						
1003	Publicly Owned Treatment Works	4.87	0.01	35.09	0.10	29.48	0.08
1005	Treatment, Storage & Disposal Facilities	0.02	0.00				
1006	Landfills	49.28	0.14	1.97	0.01	1.97	0.01
1007	Other	9.84	0.03	0.43	0.00	0.26	0.00
	Subtotal	**64.00**	**0.18**	**37.49**	**0.11**	**31.71**	**0.09**
	Miscellaneous:						
1403	Catastrophic/Accidental Releases	26.24	0.00				
1404	Repair Shops	1.23	0.00				
1406	Cooling Towers	1.93	0.01				
	Subtotal	**29.40**	**0.01**				
	GRAND TOTAL:	**5,948.67**	**21.96**	**5,473.69**	**21.06**	**1,789.07**	**6.55**

Table 1-6. Point Source VOC Annual and Ozone Season Day Totals

	VOC tons/yr	VOC lbs/day
Point Sources Inside NAA	5,165.19	38,825
Point Sources Outside NAA	783.48	5,089
Total	5,948.67	43,914

1.2.2 Area Sources

The area source category includes numerous small stationary sources that when added together contribute significant amounts of air pollution. Examples of area source categories include gas stations, vehicle refueling, coating of wood furniture, and waste incineration.

Daily ozone season VOC emissions from area sources total 91.01 tons of VOC, 22.63 tons of NO_x and 46.42 tons of CO per day. The area source category contributes 28.19 percent of the total estimated VOC emissions, 7.55 percent of the NO_x emissions, and 3.96 percent of the total CO emissions for the peak season day.

Table 1-7 provides an overview of major source categories, while a more detailed breakdown of sources is contained in Section 3. There are seven major VOC sources which emit more than 5 tons of VOC per ozone season day: tank truck unloading, vehicle refueling, architectural coatings, auto refinishing, graphic arts, asphalt paving, and consumer/commercial solvent use.

Table 1-7. Summary of All Area Source 1999 Emissions by Category

Category	VOC tons/yr	VOC tons/day	NO_x tons/yr	NO_x tons/day	CO tons/yr	CO tons/day
External and Internal Combustion Sources	2,392.58	1.45	7,615.72	20.61	4,203.38	5.53
Industrial Processes	614.94	2.33	0.00	0.00	0.00	0.00
Solvent Utilization	22,595.56	65.02	0.00	0.00	0.00	0.00
Storage and Transport	5,781.43	17.02	0.00	0.00	0.00	0.00
Waste Disposal	146.20	4.30	96.33	2.01	1,253.02	40.38
Miscellaneous	282.24	0.89	12.67	0.01	411.04	0.51
Area Source Totals:	31,812.95	91.01	7,724.72	22.63	5,867.44	46.42

1.2.3 Nonroad Mobile Sources

The nonroad mobile source category includes emissions from nonroad equipment such as lawn mowers and construction equipment in addition to locomotives and aircraft activity. A complete description of the nonroad equipment sources and the corresponding methodology used to calculate VOC, NO_x, and CO emissions for the 1999 Ozone Periodic Inventory can be found in the four documents prepared for the EPA by Energy and Environmental Analysis: Nonroad Engine Emission Inventories for CO and Ozone Nonattainment Boundaries Phoenix Area, Methodology to Calculate Nonroad Emission Inventories at the County and Sub-County Level, the Voluntary Early Ozone Plan, and the Revised Voluntary Early Ozone Plan.

The Maricopa County nonroad mobile source 1999 daily ozone season emissions are shown in Table 1-8. The nonroad mobile source category contributes 21.93 percent of the total estimated 1999 daily ozone season VOC emissions, 32.98 percent of the total estimated 1999 daily ozone season NO_x emissions, and 41.36 percent of the total estimated 1999 daily ozone season CO emissions.

Table 1-8. Summary of All Nonroad Mobile Source Emissions in 1999

Equipment Type	VOC tons/yr	VOC tons/day	NO_x tons/yr	NO_x tons/day	CO tons/yr	CO tons/day
Aircraft Activity	3,621.6	8.75	9,831.2	25.61	17,786.5	43.96
Locomotives	404.4	1.11	10,595.1	29.03	1,361.8	3.73
Nonroad Equipment	21,019.6	60.93	16,428.1	44.21	148,013.5	436.91
Totals:	**24,045.6**	**70.79**	**36,854.4**	**98.85**	**167,161.8**	**484.60**

NOTES:
– Nonroad equipment contributes 60.9 tons of VOC per ozone season day. This is 86% of the nonroad mobile estimated 1999 daily ozone season VOC emissions and represents 18.9% of total estimated 1999 daily ozone season VOC emissions.
– Nonroad equipment contributes 44.2 tons of NOx per ozone season day. This is 45% of the nonroad mobile estimated 1999 daily ozone season NOx emissions and represents 14.8% of total estimated 1999 daily ozone season NOx emissions.
– Nonroad equipment contributes 436.9 tons of CO per ozone season day. This is 90% of the nonroad mobile estimated 1999 daily ozone season CO emissions and represents 37.3% of total estimated 1999 daily ozone season CO emissions.

1.2.4 Onroad Mobile Sources

The onroad mobile source category includes the following eight vehicle types: light-duty gas vehicles (LDGV), light-duty gas trucks (LDGT1 and LDGT2), heavy-duty gas vehicles (HDGV), light-duty diesel vehicles and trucks (LDDV and LDDT), heavy-duty diesel vehicles (HDDV), and motorcycles (MC). Emission factors for these vehicle types were calculated using MOBILE5a, the latest in a series of models approved by the U.S. Environmental Protection Agency (EPA) for the purpose of estimating motor vehicle emission factors for planning purposes. The resulting emission factors were multiplied by the vehicle miles traveled (VMT) estimates to generate emission estimates.

The Maricopa County onroad mobile source 1999 daily ozone season emissions are shown in the following tables. The onroad mobile source category contributes 28.01 percent of the total estimated 1999 daily ozone season VOC emissions, 49.10 percent of the total estimated 1999 daily ozone season NO_x emissions, and 54.12 percent of the total estimated 1999 daily ozone season CO emissions.

Table 1-9. Daily Ozone Season Onroad Mobile Source VOC Emissions by Vehicle Class (tons/day)

Vehicle Class	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTAL
% Emission Contribution	51.46	19.88	12.09	6.77	0.09	0.25	7.16	2.30	**100.0%**
Emissions (tons/day)	46.54	17.98	10.93	6.12	0.08	0.23	6.48	2.08	**90.44**

NOTES:
– Light-duty gas vehicles (LDGV) contribute 46.54 tons of VOC per ozone season day. This is 51.46 percent of the onroad mobile estimated 1999 daily ozone season VOC emissions and represents 14.41 percent of the total estimated 1999 daily ozone season VOC emissions.
– All light-duty gas and diesel cars, trucks, and motorcycles contribute 77.84 tons of VOC per 1999 ozone season day. This is 86.07 percent of the onroad mobile estimated 1999 daily ozone season VOC emissions and represents 24.11 percent of the total estimated 1999 daily ozone season VOC emissions. (LDGV + LDGT1 + LDGT2 + LDDV + LDDT + MC = 77.84 tons).

Table 1-10. Daily Ozone Season Onroad Mobile Source NO_x Emissions by Vehicle Class (tons/day)

Vehicle Class	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTAL
% Emission Contribution	38.43	13.49	7.91	8.27	0.16	0.43	31.11	0.20	**100.0%**
Emissions (tons/day)	56.55	19.85	11.64	12.16	0.24	0.63	45.77	0.30	**147.14**

NOTES:
– Light-duty gas vehicles (LDGV) contribute 56.55 tons of NOx per ozone season day. This is 38.43 percent of the onroad mobile estimated 1999 daily ozone season NOx emissions and represents 18.87 percent of the total estimated 1999 daily ozone season NOx emissions.
– All light-duty gas and diesel cars, trucks, and motorcycles contribute 89.21 tons of NOx per 1999 ozone season day. This is 60.63 percent of the onroad mobile estimated 1999 daily ozone season NOx emissions and represents 29.77 percent of the total estimated 1999 daily ozone season NOx emissions. (LDGV + LDGT1 + LDGT2 + LDDV + LDDT + MC = 89.21 tons).

Table 1-11. Daily Ozone Season Onroad Mobile Source CO Emissions by Vehicle Class (tons/day)

Vehicle Class	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTAL
% Emission Contribution	51.87	20.94	12.18	8.93	0.03	0.08	5.05	0.92	**100.0%**
Emissions (tons/day)	328.94	132.79	77.22	56.64	0.18	0.49	32.02	5.83	**634.11**

NOTES:
– Light-duty gas vehicles (LDGV) contribute 328.94 tons of CO per ozone season day. This is 51.87 percent of the onroad mobile estimated 1999 daily ozone season CO emissions and represents 28.07 percent of the total estimated 1999 daily ozone season CO emissions.
– All light-duty gas and diesel cars, trucks, and motorcycles contribute 545.45 tons of CO per 1999 ozone season day. This is 86.02 percent of the onroad mobile estimated 1999 daily ozone season CO emissions and represents 46.55 percent of the total estimated 1999 daily ozone season CO emissions. (LDGV + LDGT1 + LDGT2 + LDDV + LDDT + MC = 545.45 tons).

1.2.5 Biogenic Sources

Biogenic sources include all vegetation in the nonattainment area. This includes indigenous vegetation, crops, and landscaping vegetation. The computer program MAG-BEIS2 was used to estimate hourly VOC emissions (isoprene, *a*-pinene, other monoterpenes, and unidentified hydrocarbons). Annual biogenic emissions were not determined. The estimated 1999 daily ozone season emissions from biogenics are 48.67 tons VOC and 10.03 tons of NO_x per day. Biogenic emissions comprise 15.1 percent of total VOC and 3.3 percent of total NO_x season day emissions.

1.2.6 Summary of All Emission Source Types

Tables 1-12 and 1-13 below show the 1999 annual and season day VOC, NO_x, and CO for the five primary categories listed in this 1999 Ozone Periodic Emission Inventory. Note that in Table 1-13, annual emissions for onroad mobile and biogenic sources are not required by EPA inventory guidance to be calculated, so the totals in that table do not reflect true totals. Tables 1-14 and 1-15 present comparative emissions data by source type reported in periodic ozone inventories since 1990. Table 1-14 presents data for annual emissions, while Table 1-15 summarizes season day emissions.

Table 1-12. 1999 Average Daily Ozone Season Emissions (tons/day)

	VOC		NO_x		CO	
Source	**tons/day**	**%**	**tons/day**	**%**	**tons/day**	**%**
Stationary Point:						
– Inside the non-attainment area	19.42	6.01	20.86	6.96	6.45	0.55
– Outside the non-attainment area	2.54	0.79	0.20	0.07	0.10	0.01
Area	91.01	28.19	22.63	7.55	46.42	3.96
Nonroad Mobile	70.79	21.93	98.85	32.98	484.60	41.36
Onroad Mobile	90.44	28.01	147.14	49.10	634.11	54.12
Biogenic	48.66	15.07	10.02	3.34	0	
TOTAL DAILY EMISSIONS:	**322.86**	**100.0**	**299.70**	**100.0**	**1,171.68**	**100.0**

Table 1-13. 1999 Annual Ozone Precursor Emissions (tons/yr)

Source Category	**VOC**	**NO_x**	**CO**
Stationary Point:			
– Inside the non-attainment area	5,165.19	5,408.86	1,755.56
– Outside the non-attainment area	783.48	64.84	33.51
Area	31,812.95	7,724.72	5,867.44
Nonroad Mobile	24,045.60	36,854.40	167,161.80
Onroad Mobile[1]	n/a	n/a	n/a
Biogenic[1]	n/a	n/a	n/a
TOTAL ANNUAL EMISSIONS:[2]	**61,807.22**	**50,052.82**	**175,398.51**

[1] Inventory guidance does not require annual emissions estimates for onroad mobile and biogenic sources.
[2] Annual total emissions do not include onroad mobile and biogenic sources.

Table 1-14. Comparison of Annual Emissions Reported in Periodic Inventories from 1990 to Present (in tons per year)

Source Type	**Pollutant**	**1990**	**1993**	**1996**	**1999**
Point	CO	1,493	1,140	735.6	1,789.07
	VOC	7,930	7,699	5,866	5,948.67
	NO_x	5,954	4,721	3,319.1	5,473.70
Area	CO	2,237	2,335	1,677.8	5,867.44
	VOC	35,728	36,447	39,549.8	31,812.95
	NO_x	3,708	3,779	4,589.4	7,724.72
Nonroad Mobile	CO	167,302.8	162,021	181,911.7	167,161.80
	VOC	17,923.5	17,377	38,944.9	24,045.60
	NO_x	29,081.5	28,619	13,907.7	36,854.40
Totals:	CO	171,032.8	165,496	184,325.1	174,818.31
	VOC	61,581.5	61,523	84,360.7	61,807.22
	NO_x	38,743.5	37,119	21,816.2	50,052.82

Table 1-15. Comparison of Ozone Season Day Emissions Reported in Periodic Inventories from 1990 to Present (in tons per year)

Source Type	Pollutant	1990	1993	1996	1999
Point	CO	15.21	14.19	8.88	6.55
	VOC	28.16	25.63	23.57	21.96
	NO_x	78.04	77.78	44.44	21.06
Area	CO	4.28	4.5	4.6	46.42
	VOC	123	110	108.90	91.01
	NO_x	8	9.8	11.5	22.63
Nonroad Mobile	CO	573.2	658	621.6	484.60
	VOC	63.7	62.1	66.3	70.79
	NO_x	93.7	92.6	32	98.85
Onroad Mobile	CO	1,002.61	853	621.5	634.11
	VOC	150.11	119	95.1	90.44
	NO_x	143.12	144	142.8	147.14
Biogenic	VOC	41	52	52.1	48.66
	NO_x	0	0	11.6	10.02
Totals:	CO	1,595.30	1,529.69	1,256.58	1,171.68
	VOC	405.97	368.73	345.97	322.86
	NO_x	322.86	324.18	242.34	299.70

1.3 References for Section 1

Arizona Department of Environmental Quality. Voluntary Early Ozone Plan. Phoenix, Arizona. 1996.

Arizona Department of Environmental Quality. Revised Voluntary Early Ozone Plan. Phoenix, Arizona. 1997.

Energy and Environmental Analysis, Inc. Methodology to Calculate Nonroad Emission Inventories at the County and Sub-County Level Draft Final Report. Arlington, Virginia. July 1992.

Energy and Environmental Analysis, Inc. Nonroad Engine Emission Inventories for CO and Ozone Nonattainment Boundaries Phoenix Area. Arlington, VA. 1992.

Environmental Protection Agency. Emission Inventory Requirements for Ozone State Implementation Plans, EPA-450/4-91-010. March 1991.

Maricopa Association of Governments. Update of the Population and Socioeconomic Database for Maricopa County. March 1993.

Maricopa County Environmental Services Department. 1990 Base Year Carbon Monoxide Emission Inventory. August 1993.

Maricopa County Environmental Services Department. 1993 Periodic Ozone Emission Inventory. September 1996.

Maricopa County Environmental Services Depart ment. 1996 Base Year Ozone Emission Inventory Preparation Plan. October 1997.

US Government Office of the Federal Register National Archives and Records Administration. Code of Federal Regulations, 56 FR 56694. November 6, 1991.

SECTION 2. STATIONARY POINT SOURCES

2.1 Introduction and Scope

Maricopa County Environmental Services Department (MCESD) is the lead agency responsible for compiling this 1999 emissions point source inventory. MCESD is also responsible for identifying all point sources within the nonattainment area, documenting the methods used to calculate emissions from each source, and collating and presenting the results. For the purposes of this inventory, a point source is a stationary operation in the nonattainment area or within a 25-mile boundary zone around the nonattainment area that meets the following criteria:

- It annually emitted at least 25 English (short) tons of volatile organic compounds (VOC), 50 English tons or more of carbon monoxide (CO), and or 100 English tons of nitrogen oxides (NO_x) in 1999; OR
- It was included as a point source in the 1990, 1993, or 1996 ozone periodic emission inventories and has VOC, CO or NO_x emissions greater than 5 English tons per year.

The point source inventory consists of actual VOC, NOx, and CO emissions for the year 1999 and for the average daily ozone season. The ozone season, defined as July through September 1999, is based on ozone exceedances from 1981 through 1991 (defined in Section 1.1) to be consistent with the 1990 base year inventory. A description and map of the nonattainment area are provided in Section 1. Questions concerning point source emissions may be directed to Bob Downing of MCESD at (602) 506-6790.

Several tables have been constructed to provide the point source emissions and category totals. Table 2-1 shows the point source categories that were considered when developing the inventory. (Not all categories were applicable to this inventory.) Table 2-2 provides an alphabetical list of the 188 identified point sources and their location, while Table 2-3 shows the 1999 annual and average daily ozone season emissions for those point sources. Table 2-4 indicates the 1999 annual and average daily ozone season emissions for these point sources, listed by industry category. Categories were designated according to Level II (4-digit) Tier II codes and process descriptions provided by the point sources. Table 2-5 summarizes emissions by category for all points. Table 2-6 presents annual and season day VOC emissions totals by groupings of categories and location (i.e., sources that are inside and outside the nonattainment area).

Table 2-1. Point Source Categories

Tier Code		Status
TIER 01	**Fuel Combustion: Electric Utilities**	
0101	Coal	Not present in area
0102	Oil	Treated as point sources
0103	Gas	Treated as point sources
0104	Other	Not present in area
0105	Internal Combustion	Treated as point sources

Table 2-1 (continued). Point Source Categories

Tier Code		Status
TIER 02	**Fuel Combustion: Industrial**	
0201	Coal	Not present in area
0202	Oil	Point and area source
0203	Gas	Point and area source
0204	Other	Point and area source
0205	Internal Combustion	Point and area source
TIER 03	**Fuel Combustion: Other**	
0301	Commercial/Institutional Coal	Not present in area
0302	Commercial/Institutional Oil	Point and area source
0303	Commercial/Institutional Gas	Point and area source
0304	Misc. Fuel Combustion (Except Residential)	Point and area source
0305	Residential Wood	Area source (addressed in Section 3)
0306	Residential Other	Area source (addressed in Section 3)
TIER 04	**Chemical and Allied Product Manufacturing**	
0401	Organic Chemical Manufacturing	Not present in area
0402	Inorganic Chemical Manufacturing	Not present in area
0403	Polymer & Resin Manufacturing	Point and area source
0404	Agricultural Chemical Manufacturing	Point source
0405	Paint, Varnish, Lacquer and Enamel Mfg.	Point source
0406	Pharmaceutical Manufacturing	Point and area source
0407	Other Chemical Manufacturing	Not present in area
TIER 05	**Metals Processing**	
0501	Non-Ferrous Metals Processing	Point source
0502	Ferrous Metals Processing	Point source
0503	Metals Processing, not elsewhere classified	Point source
TIER 06	**Petroleum and Related Industries**	
0601	Oil & Gas Production	Not present in area
0602	Petroleum Refineries & Related Industries	Not present in area
0603	Asphalt Manufacturing	Not present in area
TIER 07	**Other Industrial Processes**	
0701	Agriculture, Food, & Kindred Products	Point and area source
0702	Textiles, Leather, & Apparel Products	Point and area source
0703	Wood, Pulp & Paper, & Publishing Products	Point and area source
0704	Rubber & Miscellaneous Plastic Products	Point and area source
0705	Mineral Products	Point and area source
0706	Machinery Products	Area source (addressed in Section 3)
0707	Electronic Equipment	Point and area source
0708	Transportation Equipment	Area source (addressed in Section 3)
0709	Construction	Area source (addressed in Section 3)
0710	Miscellaneous Industrial Processes	Point and area source

Table 2-1 (continued). Point Source Categories

Tier Code		Status
TIER 08	**Solvent Utilization**	
0801	Degreasing	Point and area source
0802	Graphic Arts	Point and area source
0803	Dry Cleaning	Area source (addressed in Section 3)
0804	Surface Coating	Point and area source
0805	Other Industrial	Point and area source
0806	Non-industrial	Point and area source
0807	Solvent Utilization not elsewhere classified	Point and area source
TIER 09	**Storage and Transport**	
0901	Bulk Terminals & Plants	Point source
0902	Petroleum & Petroleum Product Storage	Point source
0903	Petroleum & Petroleum Product Transport	Area source (addressed in Section 3)
0904	Service Stations: Stage I	Area source (addressed in Section 3)
0905	Service Stations: Stage II	Area source (addressed in Section 3)
0906	Service Stations: Breathing & Emptying	Area source (addressed in Section 3)
0907	Organic Chemical Storage	Point and area source
0908	Organic Chemical Transport	Area source (addressed in Section 3)
0909	Inorganic Chemical Storage	Area source (addressed in Section 3)
0910	Inorganic Chemical Transport	Area source (addressed in Section 3)
0911	Bulk Materials Storage	Point and area source
0912	Bulk Materials Transport	Area source (addressed in Section 3)
TIER 10	**Waste Disposal and Recycling**	
1001	Incineration	Area source (addressed in Section 3)
1002	Open Burning	Area source (addressed in Section 3)
1003	Publicly Owned Treatment Works	Point source
1004	Industrial Waste Water	Accounted for in each point source's emissions (based on mass balance)
1005	Treatment, Storage and Disposal Facilities	Point source
1006	Landfills	Point and area source
1007	Other	Point and area source
TIER 11	**Highway Vehicles**	
1101	Light-Duty Gas Vehicles & Motorcycles	Onroad mobile source (addressed in Section 5)
1102	Light-Duty Gas Trucks	Onroad mobile source (addressed in Section 5)
1103	Heavy-Duty Gas Vehicles	Onroad mobile source (addressed in Section 5)
1104	Diesels	Onroad mobile source (addressed in Section 5)
TIER 12	**Off-Highway**	
1201	Non-Road Gasoline	Nonroad mobile source (addressed in Section 4)
1202	Non-Road Diesel	Nonroad mobile source (addressed in Section 4)
1203	Aircraft	Nonroad mobile source (addressed in Section 4)
1204	Marine Vessels	Not present in area
1205	Railroads	Nonroad mobile source (addressed in Section 4)
TIER 13	**Natural Sources**	
1301	Biogenic	Biogenic source (addressed in Section 6)
1302	Geogenic	Biogenic source (addressed in Section 6)
1303	Miscellaneous	Biogenic source (addressed in Section 6)

Table 2-1 (continued). Point Source Categories

Tier Code		Status
TIER 14	**Miscellaneous**	
1401	Agriculture & Forestry	Not included in ozone inventory
1402	Other Combustion	Not included in ozone inventory
1403	Catastrophic/Accidental Releases	Point and area source
1404	Repair Shops	Point and area source
1405	Health Services	Area source (addressed in Section 3)
1406	Cooling Towers	Point source
1407	Fugitive Dust	Not included in ozone inventory

Note: "Not present in area" means that point sources in this category are not found within the nonattainment area and thus are not included in this inventory.

2.2 Compiling the Point Source List

Maricopa County Environmental Services Department (MCESD) identified point sources within Maricopa County through its permit system database and the 1999 annual emissions reported submitted to the department. In addition, the permit system was reviewed to locate new installations that were not included in the previous emission inventory, and to identify sources that have ceased operations since 1996 periodic inventory was compiled. Sources were categorized by tier codes.

A total of 183 point sources inside the Maricopa County nonattainment area were identified. Five additional sources are located outside the nonattainment area but within the 25-mile boundary zone around the nonattainment area. MCESD identified three of these five sources (those within Maricopa County but outside the nonattainment area), while the Pinal County Air Quality Control District (PCAQCD) quantified emissions for the other two sources. There were no additional relevant sources quantified by the Arizona Department of Environmental Quality (ADEQ). Several large VOC sources included on the point source list also reported some carbon monoxide emissions. Thus the list of sources included in this section differs from the list of large CO sources used to compile the Maricopa County 1999 CO Periodic Emission Inventory.

An alphabetical list of all sources, including a unique business ID number, business name (including any changes from the 1996 periodic inventory), and physical address, is contained in Table 2-2. Business names that have changed since the 1996 periodic inventory are noted in Table 2-2. In a few additional cases, business ID numbers and/or SIC codes have been updated or corrected from data provided in the 1996 inventory.

In total, these 188 sources emitted 5,922 tons of VOC, 5,474 tons of NO_x and 1,789 tons of CO in 1999. All available information about each point source included in this inventory will be forwarded to the U.S. Environmental Protection Agency (EPA) for use in the National Emission Inventory (NEI) database, the successor to the EPA Aerometric Information Retrieval System (AIRS) for reporting emissions inventory data. The required site- and segment-level data, as outlined in the NEI data requirement documentation, will be submitted to EPA in the required formats.

Table 2-2. Location of Point Sources Included in this Inventory

ID #	SIC	Business Name	Address	City	ZIP
1075	4952	91st Ave. Wastewater Treatment Plant	5615 S. 91st Ave.	Tolleson	85353
1330	2599	A. Forzano & Son Inc.	8120 W. Harrison St.	Phoenix	85043
245	2511	A.F. Lorts Co. Inc. (formerly *Lorts Manufacturing Co.*)	3020 Civic Center Plaza	Scottsdale	85251
1239	3412	AG Products/American Gooseneck Inc.	2525 W. Broadway Rd.	Phoenix	85041
35541	3317	Allied Tube & Pipe Conduit Corp.	2525 N. 27th Ave.	Phoenix	85009
199	3272	Ameron Pipe	2325 S. 7th St.	Phoenix	85034
3313	4911	APS West Phoenix Power Plant	4606 W. Hadley St.	Phoenix	85043
3441	5171	Arco Products Co. / Phoenix Terminal	5333 W. Van Buren St.	Phoenix	85043
43135	3088	Arizona Pacific Spas	210 N. 24th St.	Phoenix	85034
1476	2511	Aspen Furniture LLC	3711 W. Clarendon Ave.	Phoenix	85019
1331	2517	Aspen II (formerly *RTA Manufacturing Inc.*)	3021 N. 29th Dr.	Phoenix	85017
4028	2752	B & D Litho Inc.	3820 N. 38th Ave.	Phoenix	85019
1418	3069	B.F. Goodrich Aircraft Evacuation Systems	505 N. 51st Ave.	Phoenix	85043
18	3069	Belden Communications Division	3414 S. 5th St.	Phoenix	85040
961	7996	Big Surf	1500 N. McClintock Dr.	Tempe	85281
36485	2759	Billboard Poster Co. Inc.	3940 W. Montecito Ave.	Phoenix	85019
3528	5171	Brown-Evans Distributing BP#1	306 S. Country Club Dr.	Mesa	85211
458	2431	Bryant Industries Inc.	788 W. Illini St.	Phoenix	85041
975	2752	Buse Printing & Advertising	1616 E. Harvard St.	Phoenix	85006
3442	5171	Caljet / Williams	125 N. 53rd Ave.	Phoenix	85043
3296	5171	Calvert Oil Co. †	214 Arizona Eastern Ave.	Buckeye	85326
40927	2521	Case Products	1401 E. Jackson St.	Phoenix	85034
1316	2451	Cavco Industries Inc. (Litchfield Rd.)	1366 S. Litchfield Rd.	Goodyear	85338
1317	2451	Cavco Industries Inc. (35th Ave.)	2602 S. 35th Ave.	Phoenix	85009
1318	2451	Cavco Industries Inc. (Durango St.)	2502 W. Durango St.	Phoenix	85009
16	3441	Cem-Tec Corporation	3745 S. 7th Ave.	Phoenix	85041
1310	2752	Century Graphics LLC	2960 Grand Ave.	Phoenix	85017
1426	2759	Cesar Color Inc.	3433 E. Wood St.	Phoenix	85040
1303	3111	Chambers Belt Co. Inc.	2920 E. Chambers St.	Phoenix	85040
996	5511	Chapman Chevrolet-Isuzu Inc.	1717 E. Baseline Rd.	Tempe	85283
3297	5171	Chevron USA Inc.	5110 W. Madison St.	Phoenix	85043
3976	2434	Cholla Custom Cabinets Inc.	1727 E. Deer Valley Dr.	Phoenix	85024
4083	2431	Chris Fischer Productions Inc.	4741 W. Polk St.	Phoenix	85043
1074	4952	City of Phoenix 23rd Ave. WWTP	2301 W. Durango St.	Phoenix	85009
40233	9511	City of Scottsdale Water Services Div.	16800 N. Hayden Rd.	Scottsdale	85261
38731	2451	Clayton Homes - El Mirage	12345 W. Butler Dr.	El Mirage	85335
25621	8711	CMC Wireless Component	10409 S 50th Pl.	Phoenix	85044
1054	2434	Copperstate Cabinet Co. Inc.	1932 W. North Ln.	Phoenix	85021
31570	3052	Copperstate Rubber of Arizona	750 S. 59th Ave.	Phoenix	85215
1198	2752	Courier Graphics Corp.	2621 S. 37th St.	Phoenix	85034
4023	2431	Creative Shutters Inc.	2009 W. Ironwood Dr.	Phoenix	85021
3744	3089	Desert Sun Fiberglass Systems Ltd.	21412 N. 14th Ave.	Phoenix	85027
130	3324	Dolphin Inc.	740 S. 59th Ave.	Phoenix	85043
36224	7532	Earnhardt Dodge Auto Body	1301 N. Colorado St.	Gilbert	85234
26	5082	Empire Machinery Co.	1725 S. Country Club Dr.	Mesa	85210
544	2451	Fleetwood Homes of Arizona Inc. #21	6112 N. 56th Ave.	Glendale	85311
27728	3674	Flipchip Technologies	3701 E. University Dr.	Phoenix	85034
1375	2511	Forest Designs	3230 E. Roeser Rd.	Phoenix	85040
779	2752	G & G Printers Inc.	10201 N. 21st Ave.	Phoenix	85021
365	2653	Gaylord Container Corp.	4932 W. Colter St.	Glendale	85301
41751	7534	GCR Truck Tire Center	2815 N. 32nd Ave.	Phoenix	85009

† = Point source is outside the nonattainment area.

Table 2-2 (continued). Location of Point Sources Included in this Inventory

ID #	SIC	Business Name	Address	City	ZIP
1437	3672	Hadco Phoenix Inc./ Sanmina Phx. Div. (formerly *Continental Circuits Corp.*)	5020 S. 36th St.	Phoenix	85040
292	2834	Health Factors International Inc. (formerly *JMI Phoenix Laboratories Inc.*)	429 S. Siesta Ln.	Tempe	85281
31565	3086	Henry Products Inc.	302 S. 23rd Ave.	Phoenix	85009
1305	2752	Heritage Graphics Inc.	2926 N. 33rd Ave.	Phoenix	85015
138	2431	Heritage Shutters Inc.	602 W. Lone Cactus Dr.	Phoenix	85027
Pinal		Hexcel	1214 W. Highway 84	Casa Grande	85222
40222	3663	Hexcel Satellite Products	1331 W. Houston Ave.	Gilbert	85233
529	3086	Highland Products Inc.	43 N. 48th Ave.	Phoenix	85043
3536	2051	Holsum Bakery Inc.	408 S. 23rd Ave.	Phoenix	85009
3802	2051	Holsum Bakery (Tempe)	710 W. Geneva Dr.	Tempe	85252
1059	3724	Honeywell Aerospace Services (formerly *AlliedSignal Aviation Serv.*)	1944 E. Sky Harbor Cir.	Phoenix	85034
348	3812	Honeywell Air Transport Systems (formerly *Honeywell Comm Flight Systems*)	21111 N. 19th Ave.	Phoenix	85027
247	3728	Honeywell Engines & Systems (formerly *AlliedSignal Aerospace Equip Systems*)	1300 W. Warner Rd.	Tempe	85284
355	3724	Honeywell International Inc. (formerly *AlliedSignal Engines*)	19019 N. 59th Ave.	Glendale	85308
1041	3769	Honeywell Satellite Systems Operations	111 S. 34th St.	Phoenix	85034
354	3341	Imsamet of Arizona	3829 S. Estrella Pkwy.	Goodyear	85338
1080	3679	Innovex Southwest Inc. (formerly *Adflex Solutions Inc.*)	2001 W. Chandler Blvd.	Chandler	85224
777	3086	Insulfoam (formerly *Western Insulfoam*)	3401 W. Cocopah St.	Phoenix	85009
31617	3674	Intel Corp. Chandler Campus (Fab 6)	5000 W. Chandler Blvd.	Chandler	85226
3966	3674	Intel Corp. Ocotillo Campus (Fab 12)	4500 S. Dobson Rd.	Chandler	85248
1483	3479	Interpipe Equipment Inc. (formerly *Interpipe Inc.*)	3807 W. Adams St.	Phoenix	85009
790	3479	Intesys Technologies Inc.	500 S. 52nd St.	Tempe	85281
654	2752	Ironwood Lithographers Inc.	455 S. 53rd St.	Tempe	85281
983	3679	Isola Laminate Systems Corp. (formerly *AlliedSignal Laminate Systems*)	165 S. Price Rd.	Chandler	85224
813	2851	Kelly-Moore Paint Co. Inc. (formerly *K-M Universal Paint Co. Inc.*)	905 W. Alameda Dr.	Tempe	85282
788	2431	Kirkwood Shutters Ltd.	22201 N. 24th Ave.	Phoenix	85027
341	3088	L & M Laminates and Marble	813 E. University Dr.	Phoenix	85034
4182	2511	Legends Furniture Inc.	5555 N. 51st Ave.	Glendale	85301
4360	2752	Litho Tech Inc.	2020 N. 22nd Ave.	Phoenix	85009
1276	7538	Lou Grubb Chevrolet	2646 W. Camelback Rd.	Phoenix	85017
3300	9711	Luke Air Force Base	14002 W. Marauder St.	Glendale	85309
744	3325	M.E. West Castings Inc. (formerly *Capitol Castings Inc.*)	5857 S. Kyrene Rd.	Tempe	85283
1248	3088	Maax Spas (formerly *Coleman Spas*)	25605 S. Arizona Ave.	Chandler	85248
4111	2512	Magic Woods Inc.	4210 N. 39th Ave.	Phoenix	85019
205	2677	Mail-Well Envelope	221 N. 48th Ave.	Phoenix	85043
353	3089	Marlam Industries Inc.	834 E. Hammond Ln.	Phoenix	85034
62	2434	Mastercraft Cabinets Inc.	305 S. Brooks	Mesa	85202
1382	2434	McCarthy Cabinet Co.	3255 W. Osborn Rd.	Phoenix	85017
971	3499	Mechtronics of Arizona Corp.	1601 E. Broadway Rd.	Phoenix	85040
1200	3674	Medtronic Microelectronics Center	2343 W. 10th Pl.	Tempe	85281
3326	3281	Mesa Fully Formed Inc.	1111 S. Sirrine St.	Mesa	85210
1414	1442	Mesa Materials Inc.	3410 N. Higley Rd.	Mesa	85205

† = Point source is outside the nonattainment area.

Table 2-2 (continued). Location of Point Sources Included in this Inventory

ID #	SIC	Business Name	Address	City	ZIP
83	3446	Metal-Weld Specialties Inc.	8137 N. 83rd Ave.	Peoria	85345
192	2521	Meyer & Lundahl Manufacturing Co.	2345 W. Lincoln St.	Phoenix	85009
1203	3674	Microchip Technology Inc. (Chandler)	2355 W. Chandler Blvd.	Chandler	85224
1875	3674	Microchip Technology Inc. (Tempe)	1200 S. 52nd St.	Tempe	85281
176	3674	Microsemi Corp.	8700 E. Thomas Rd.	Scottsdale	85251
226	3272	Monier Lifetile LLC (formerly *Monier Inc.*)	1832 S. 51st Ave.	Phoenix	85043
518	3672	Mosiac Printed Circuits Inc. (formerly *Quality Printed Circuits Corp.*)	5815 S. 25th St.	Phoenix	85040
881	3674	Motorola Inc. (Chandler)	1300 N. Alma School Rd.	Chandler	85224
1109	3674	Motorola Inc. (Tempe)	2100 E. Elliot Rd.	Tempe	85284
1151	3674	Motorola Logic & Analog Tech Group	2200 W. Broadway Rd.	Mesa	85202
223	3524	MTD Southwest Inc. (formerly *Ryobi Outdoor Products Inc.*)	550 N. 54th St.	Chandler	85226
693	3585	Munters Corp.	802 S. 59th Ave.	Phoenix	85043
1190	2434	National Countertops & Cabinet	2317 S. 15th Ave.	Phoenix	85007
36939	2834	Naturally Vitamin	14810 N. 73rd St.	Scottsdale	85260
826	3672	Nelco Technology Inc.	1104 W. Geneva Dr.	Tempe	85282
948	3086	Nesco Manufacturing Inc.	1510 W. Drake Dr.	Tempe	85283
1309	2511	New Directions Inc.	2940 W. Willetta St.	Phoenix	85009
1878	8661	North Phoenix Baptist Church	5757 N. Central Ave.	Phoenix	85012
3953	2434	Oakcraft Inc.	366 N. 2nd Ave.	Phoenix	85003
27925	2511	Oasis Bedroom Co.	7733 W. Olive Ave.	Peoria	85345
52382	4911	Ocotillo Power Plant	2022 N. 22nd Ave.	Phoenix	85009
212	3674	ON Semiconductor (formerly *Motorola SPS-SCG*)	1500 E. University Dr.	Tempe	85281
3982	2752	O'Neil Printing Inc.	5005 E. McDowell Rd.	Phoenix	85008
1344	2451	Palm Harbor Homes Inc.	309 S. Perry Ln.	Tempe	85281
98	4911	Palo Verde Nuclear Generating Station †	5801 S. Wintersburg Rd.	Tonopah	85354
733	7699	Pan-Glo West	2401 W. Sherman St.	Phoenix	85009
419	3724	Parker Hannifin GTFSD	7777 N. Glen Harbor Blvd.	Glendale	85307
1398	3089	Patrician Marble Co. LLP	3333 W. Osborn Rd.	Phoenix	85017
1116	2431	Patrick Door Inc.	211 S. 49th Ave.	Phoenix	85043
1341	3949	Penn Racquet Sports	306 S. 45th Ave.	Phoenix	85043
1014	3251	Phoenix Brick Yard	1814 S. 7th Ave.	Phoenix	85007
69	3398	Phoenix Heat Treating Inc.	2405 W. Mohave Rd.	Phoenix	85009
562	2711	Phoenix Newspapers Inc.	22600 N. 19th Ave.	Phoenix	85027
30171	4111	Phoenix Transit System	2225 W. Lower Buckeye Rd.	Phoenix	85009
4050	2051	Pillsbury Bakeries & Food Service	1120 W. Fairmont Dr.	Tempe	85282
1154	3449	Ping Inc. (formerly *Karsten Mfg Corp.*)	2201 W. Desert Cove Ave.	Phoenix	85029
4007	3479	Precision Truck Painting & Repair Inc.	2212 N. 27th Ave.	Phoenix	85009
148	3369	Presto Casting Co.	5440 W. Missouri Ave.	Glendale	85301
1030	2752	Quebecor World – Phoenix Div.	1850 E. Watkins St.	Phoenix	85034
991	3479	Randall's VIP Trailers Inc.	17066 S 54th St.	Chandler	85226
1503	2451	Redman Homes Inc.	400 E. Ray Rd.	Chandler	85225
3773	3089	Redstone Industries Inc.	5820 W. San Miguel Ave.	Glendale	85301
303	3411	Rexam Beverage Can Co. (formerly *American National Can Corp.*)	211 N. 51st Ave.	Phoenix	85043
545	3672	Rockford Corp.	546 S. San Miguel Ave.	Tempe	85281
508	2511	Samuel Lawrence Furniture Co.	601 S. 65th Ave.	Phoenix	85043
3315	4911	Santan Generating Plant	1005 S. Val Vista Dr.	Gilbert	85296
266	3441	Schuff Steel Co.	420 S. 19th Ave.	Phoenix	85009
246	2451	Schult Homes †	231 N. Apache Rd.	Buckeye	85326

† = Point source is outside the nonattainment area.

Table 2-2 (continued). Location of Point Sources Included in this Inventory

ID #	SIC	Business Name	Address	City	ZIP
4278	2431	Scottsdale Shutters Inc.	16087 N. 80th St.	Scottsdale	85260
207	3732	Sea Ray Boats	4140 E. Raymond St.	Phoenix	85040
4175	4226	SFPP LP	49 N. 53rd Ave.	Phoenix	85043
Pinal		Sierra Estrella Landfill †	22087 N. Ralston Rd.	Maricopa	85239
27933	4953	Skunk Creek Landfill	3165 W. Happy Valley Rd.	Phoenix	85027
3316	4911	SRP Agua Fria	7302 W. Northern Ave.	Glendale	85303
3317	4911	SRP Kyrene Steam Plant	7005 S. Kyrene Rd.	Tempe	85283
4131	3674	ST Microelectronics (formerly *SGS Thomson Microelectronics Inc.*)	1000 E. Bell Rd.	Phoenix	85022
582	2511	Stone Creek Inc.	4221 E. Raymond St.	Phoenix	85040
388	3086	Storopack Inc.	77 N. 45th Ave.	Phoenix	85043
27	3632	Sub Zero Freezer Co. Inc.	3865 W. Van Buren St.	Phoenix	85009
1463	2431	Sunburst Shutters Inc.	3637 E. Maricopa Fwy.	Phoenix	85040
101	2011	Sunland Beef Co.	651 S. 91st Ave.	Tolleson	85353
3691	5171	Supreme Oil Co.	2110 Grand Ave.	Phoenix	85009
40236	2752	Team Forms	2002 N. 23rd Ave.	Phoenix	85009
3978	2511	Team Two Design Associates Inc.	310 S. 43rd Ave.	Phoenix	85009
1333	7997	Ted Levine Drum Co.	303 S. Sirrine St.	Mesa	85210
3444	5171	Texaco Phoenix Sales Terminal	5325 W. Van Buren St.	Phoenix	85043
249	3721	The Boeing Company (formerly *McDonnell Douglas Helicopter Systems*)	5000 E. McDowell Rd.	Phoenix	85215
937	3799	The Heil Co.	1500 S. 7th St.	Phoenix	85034
232	7011	The Phoenician Resort	6000 E. Camelback Rd.	Scottsdale	85251
552	2511	Thornwood Furniture Manufacturing	5125 E. Madison St.	Phoenix	85034
363	2511	Thunderbird Furniture	7501 E. Redfield Rd.	Scottsdale	85260
3443	5171	Tosco Phoenix Terminal (formerly *Union Oil Co.*)	10 S. 51st Ave.	Phoenix	85043
532	2761	Trade Printers Inc.	2122 W. Shangri-La Rd.	Phoenix	85029
782	3471	Treffers Precision Inc.	1021 N. 22nd Ave.	Phoenix	85009
1210	2511	Trendwood Inc. (15th Ave.)	2402 S. 15th Ave.	Phoenix	85007
1211	2511	Trendwood Inc. (University Ave.)	261 E. University Dr.	Phoenix	85004
169	7538	U-Haul Intl. Technical Center	11298 S Priest Dr.	Tempe	85284
1228	3087	Ultra Installations Inc.	245 S. Mulberry	Mesa	85202
234	2023	United Dairymen of Arizona	2008 S. Hardy Dr.	Tempe	85282
201	1442	United Metro Materials Inc. Plant #1	2875 S. 7th Ave.	Phoenix	85041
260	1442	United Metro Plant #11	3640 S. 19th Ave.	Phoenix	85009
213	1442	United Metro Plant #12	11920 W Glendale Ave.	Glendale	85307
89	2452	United Modular (formerly *Rosewood Enterprises*)	5301 W. Madison St.	Phoenix	85043
827	3479	Valley Industrial Painting	1131 W. Watkins St.	Phoenix	85007
403	3354	VAW of America Inc. (formerly *VAW Aluminum*)	249 S. 51st Ave.	Phoenix	85043
2	2951	Vulcan Materials Co. Western Div.	14521 N 115th Ave.	El Mirage	85335
174	2899	W.R. Meadows of AZ Inc.	2636 S. Sarival Ave.	Goodyear	85338
1149	2431	Weaver Quality Shutters Inc.	218 S. 15th St.	Phoenix	85034
376	2671	Western Packaging	6051 N. 56th Ave.	Glendale	85301
4384	2431	Western Shutter LLC	4038 E. Madison St.	Phoenix	85034
2701	5171	Western States Petroleum #107	3331 W. Broadway Rd.	Phoenix	85041
20706	3086	WinCup Holdings Inc.	7980 W. Buckeye Rd.	Phoenix	85048
3324	2752	Woods Lithgraphics Inc.	3433 W. Earll Dr.	Phoenix	85017
72	2511	Woodstuff Manufacturing Inc.	1635 S. 43rd Ave.	Phoenix	85009
70	3069	Wynn's Precision Inc.	708 W. 22nd St.	Tempe	85282

† = Point source is outside the nonattainment area.

2.3 Procedures for Estimating Emissions from Point Sources

Emission estimates for both the annual 1999 and the average daily ozone season were determined from annual source emission reports, MCESD investigation reports, permit files and logs, or telephone contacts with sources. For most of the sources, material balance methods were used for determining emissions. Emissions were estimated using the emission factors from AP-42, source tests, engineering calculations, or manufacturers' specifications.

MCESD distributes annual emissions survey forms to nearly all facilities for which MCESD has issued an operating permit. Facilities are required to report detailed information on stacks, control devices, and process-level information concerning their annual activities. (See Appendix 2-1 for examples of emissions reports that facilities submitted to MCESD for 1999). After a facility has submitted an emissions report to MCESD, emissions inventory staff check all emissions reports for missing and questionable data and check the accuracy and reasonableness of all emissions calculations with AP-42, the Factor Information and REtrieval (FIRE) software, and other EPA documentation. Control efficiencies are determined by source tests when available, or by AP-42 factors, engineering calculations, or manufacturers' specifications otherwise. MCESD has conducted annual emissions surveys for permitted facilities since 1988, and the department's database system, EMS, contains numerous automated quality assurance/quality control checks for data input and processing. Thus MCESD is confident that the information obtained by the emissions reports is reliable.

Rule effectiveness (RE) is applied to those sources affected by a regulation and for which emissions are determined by means of emission factors and control efficiency estimates. Rule effectiveness of 80 percent is applied to those sources that calculated emissions using control device capture and control estimates. An alphabetical list and a categorical list of point sources to which rule effectiveness has been applied are provided in Tables 2-3 and 2-4, respectively.

The following equation, from EPA's Handbook for Criteria Pollutant Inventory Development (EPA, 1999), was used to account for rule effectiveness and seasonal adjustments:

$$E_s = \frac{E_a \cdot T_s}{D \cdot W_s}\left[1 - (C_e)\,(RE)\right]$$

where: E_s = Seasonally adjusted emissions (lbs/day)
E_a = Annual emissions of VOC, NO_x, or CO (lbs/year)
T_s = Throughput for ozone season as a fraction of annual throughput.
D = Days in operation per week (days/week)
W_s = Weeks of ozone season (weeks/year)
C_e = Control efficiency
RE = Rule effectiveness (80%)

The equation was adapted for annual emissions:

E_s = [(Annual Throughput × EF – (Offsite recycling and disposal)] · [1 – (C_e) (RE)]

The following examples show how emission estimates were obtained for the point sources listed in Table 2-3.

2.3.1 Example 1: SRP Agua Fria (power plant)

General Facility Information: Salt River Project (SRP) operates a peaking electric generating plant with three gas/oil-fired boilers and three turbines. The plant is brought on line when extra generating capacity is needed during periods of peak demand. To provide a reasonable calculation for ozone season daily emissions, SRP provided its operating schedule for the ozone season day during which the most electricity was generated. Since over 99% of the fuel used is natural gas, ozone season daily emissions are calculated as gas-fired. Those emission factors used by the facility for gas-fired utility boilers and gas turbines were used and applied to the hourly consumption rate. Total annual emissions from boilers and turbines are summed to obtain the facility's total annual VOC, NO_x, and CO emissions. SRP Agua Fria provided the following information.

1. Ozone season daily fuel consumption (DFC) under 100% load:
   Boilers: 62.08 million cubic feet (MMCF) natural gas
   Turbines: 25.14 MMCF natural gas

2. Annual Fuel Consumption (AFC):
   – Boilers: 10,659.82 MMCF of natural gas
   4,790 gallons of #6 fuel oil
   – Turbines: 713.25 MMCF of natural gas
   260 gallons of #2 fuel oil

The emission factors used were based on fuel consumption for both boilers (from AP-42, Tables 1.4-1 and 1.4-2) and turbines (from the EPA FIRE database), as shown below:

SCC	Source	VOC	NO_x	CO
10100601	Natural gas: boilers (lb/MMCF)	5.5	190	84
10100501	Distillate oil: boilers (lb/1000 gal)	0.2	24	5
20100201	Natural gas: turbines (lb/MMCF)	1	462	115
20100101	Distillate oil: turbines (lb/1000 gal)	2.38	97.7	6.72

Annual NO_x Emissions:

Annual emissions (lbs) = Annual fuel consumption × emission factor

Example calculations for boilers:

Distillate oil boiler emissions = 4,790 gallons/yr × 24 lb NO_x/1000 gal
= 115 lbs NO_x/yr

Natural gas boiler emissions = 10,659.82 MMCF/yr × 190 lb NO_x/MMCF
= 2,025,366 lbs NO_x/yr

Total boiler emissions = 115 + 2,025,366 lbs
= 2,025,481 lbs/yr = 1,012.74 tons NOx/yr

NO_x emissions from turbines are calculated similarly using the data provided above.

Total annual NO_x emissions = Total boiler emissions + Total turbine emissions
= 1,012.74 tons + 164.77 tons
= 1,177.51 tons NO_x/yr

Ozone Season Daily NO_x Emissions:

Source emissions = daily fuel combustion (DFC) × emission factor = Total lbs/day

Example calculations for natural gas:

Natural gas boilers emissions = 62.083 MMCF/day × 190 lbs/MMCF
= 11,796 lbs NO_x/day

Natural gas turbines emissions = 25.139 MMCF/day × 462 lbs/MMCF
= 11,614 lbs NO_x/day

Total ozone season daily NO_x emissions = Total boiler emissions + Total turbine emissions
= 11,796 lbs + 11,614 lbs
= 23,410 lbs NO_x/day
= 11.71 tons NO_x/day

2.3.2 Example 2: Quebecor World – Phoenix Division (printing facility)

General Facility Information: This example is of a printing facility using both cold-set and heat-set processes. VOC emissions occur from solvent contained in the ink and solvents used for equipment clean up. The printing line using heat process inks is controlled by a thermal oxidizer, which captures evaporative solvent emissions from the dryer. A rule effectiveness factor of 80% is applied to account for variations in control efficiency over time. VOC emissions are calculated using material balances, which are reported on emissions reports. The following information was provided by the facility.

1. Total heat-process inks used in 1999 = 1,342,341 gallons.
2. Total cold-set process inks used in 1999 = 14,252 gallons.
3. Total isopropyl alcohol (fountain solution) used in 1999 = 3,415 gallons (Isopropyl alcohol is used in the dampening process.)
4. Total clean-up solvent used in 1999 = 6,505 gallons.
5. Total quantity of VOC vented to the control device in 1999 = 410,882 lbs (Includes 409,787 lbs from heat process inks and 1,095 lbs of the isopropyl alcohol).
6. Measured efficiency of the control device in 1999 = 99.9% (0.999 lbs recovered/lb captured).
7. Total quantity of VOC not vented to the control device in 1999 = 22,429 lbs
8. Operating schedule = 6 days/week; 52 weeks/year. Seasonal point source activity is reported on a June–August basis, in accordance with EPA guidance; these activity levels were applied to the July–September time period in calculating season-day emissions.

Example Calculation:

$$E_S = \frac{E_a \cdot T_S}{D \cdot W_S}\left[1 - (C_e)(RE)\right]$$

$$E_S \text{ controlled} = \frac{(410{,}882 \text{ lbs}) \cdot (0.22)}{(6 \text{ days}) \cdot (13 \text{ weeks})}\left[1 - (0.999)(0.80)\right]$$

E_s controlled = 232.7 lbs VOC per ozone season day

E_s uncontrolled = $\frac{(22{,}429 \text{ lbs}) (0.22)}{(6 \text{ days}) (13 \text{ weeks})}$ = 63.3 lbs VOC per ozone season day

E_s total = (E_s controlled) + (E_s uncontrolled)
= (232.7) + (63.3)
= 296.0 lbs VOC per ozone season day

2.3.3 Example 3: Chris Fischer Productions Inc. (painting operations)

General Facility Information: This source makes wood furniture, and one of the processes applies a vinyl seal to the wood. For 1999 the firm reported using 2,626 gallons of sealant with an emission factor of 3.22 lbs VOC/gallon, obtained from the sealant's MSDS. The company operates 5 days per week, and 30% of operations occur during the ozone season. Emissions were determined by materials mass balance.

Example Calculation:

Annual VOC = (2,626 gallons) × (3.22 lbs VOC/gal)
= 8,456 lbs/year

Ozone season day VOC emissions = $\frac{(8{,}456 \text{ lbs}) (0.30)}{(5 \text{ days}) (13 \text{ weeks})}$ = 39.0 lbs VOC/ozone season day

2.4 Emission Reduction Credits

Two facilities that closed out their equipment during 1999 notified Maricopa County to request that their emissions continue to be listed in the emission inventory for possible future use as emission reduction credits. These emission credits were included in the carbon monoxide emission inventory as well. The emission reduction credits for carbon monoxide, nitrogen oxides or volatile organic compounds are as follows:

The Scottsdale Princess Cogeneration Partnership: VOC: 3.99 tons
NO_x: 98.19 tons
CO: 12.95 tons

Anderson Clayton Oilseed Plant: VOC: 113.93 tons
NO_x: 6.40 tons
CO: 2.28 tons
SO_x: 0.03 tons

Therefore, the total emission reduction credits in 1999 are 231.37 tons.

2.5 Summary of All Point Source Emissions

There are a total of 188 point sources included in this inventory. Emissions from the 183 point sources located within the nonattainment area total 5,165 tons VOC, 5,409 tons NO_x and 1,756 tons CO per year. Emissions from five point sources located outside the nonattainment area total 783 tons VOC, 64 tons NO_x, and 34 tons CO per year. The total emissions from all point sources located both within and outside the nonattainment area are 5,949 tons VOC per year, 5,474 tons NO_x, and 1,789 tons CO. Table 2-3 lists annual and ozone season day emissions from all 188 point sources.

Table 2-3. Annual and Ozone Season Day Emissions from All Point Sources (Alphabetical List)

ID #	SIC	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1075	4952	91st Ave. Wastewater Treatment Plant	2.74	18	30.15	173	25.24	143
1330	2511	A. Forzano & Son Inc.	7.15	48				
245	2599	A.F. Lorts Co. Inc.	46.52	447	0.01	0	0.00	0
1239	3412	AG Products/American Gooseneck Inc.	15.31	100				
35541	3317	Allied Tube & Pipe Conduit Corp.	12.36	114	0.41	3	0.34	2
199	3272	Ameron Pipe	25.07	193	0.58	4	0.48	4
3313	4911	APS West Phoenix Power Plant	25.50	164	1,430.23	9,328	101.01	693
3441	5171	Arco Products Co. / Phoenix Terminal	22.63	116				
43135	3088	Arizona Pacific Spas	14.55	134				
1476	2511	Aspen Furniture LLC	108.04	798				
1331	2517	Aspen II	55.55	427				
4028	2752	B & D Litho Inc.	10.94	84				
1418	3357	B.F. Goodrich Aircraft Evacuation Sys.	70.00	538	1.28	7	2.39	26
18	3069	Belden Communications Division	23.74	183	4.21	32	3.37	14
961	7996	Big Surf	0.31	5	7.52	127	1.06	18
36485	7312	Billboard Poster Co. Inc.	22.76	210				
3528	5171	Brown-Evans Distributing BP#1	10.35	84				
458	2431	Bryant Industries Inc.	40.32	310				
975	2752	Buse Printing & Advertising	6.69	43				
3442	5171	Caljet / Williams	17.29	95			1.53	8
3296	5171	Calvert Oil Co.* †	12.93	74				
40927	2521	Case Products	10.21	79				
1316	2451	Cavco Industries Inc. (Litchfield Rd.)	24.40	188				
1317	2451	Cavco Industries Inc. (35th Ave.)	10.39	80				
1318	2451	Cavco Industries Inc. (Durango St.)	31.58	243				
16	3441	Cem-Tec Corporation	8.51	65				
1310	2752	Century Graphics LLC *	11.04	85	0.08	1	0.07	1
1426	2759	Cesar Color Inc.	12.40	95	0.02	0	0.02	0
1303	3111	Chambers Belt Co. Inc.	5.78	44				
996	5511	Chapman Chevrolet-Isuzu Inc.	0.87	7				
3297	5171	Chevron USA Inc.	23.61	122				
3976	2434	Cholla Custom Cabinets Inc.	14.14	109				
4083	2431	Chris Fischer Productions Inc.	14.41	133				
1074	4952	City of Phoenix 23rd Ave. WWTP	10.48	58	181.06	1,187	27.48	109
40233	9511	City of Scottsdale Water Services Div.	3.59	20	8.20	45	11.49	63
38731	2451	Clayton Homes - El Mirage	11.36	87				
25621	8711	CMC Wireless Component	4.79	38				
1054	2434	Copperstate Cabinet Co. Inc.	8.89	68	0.01	0	0.01	0
31570	3052	Copperstate Rubber of Arizona	5.19	43	0.20	1	0.17	1
1198	2752	Courier Graphics Corp.*	12.71	88	0.27	2	0.23	2
4023	2431	Creative Shutters Inc.	13.62	84				
3744	3089	Desert Sun Fiberglass Systems Ltd.	33.64	259				
130	3324	Dolphin Inc.	11.38	95	3.27	27	2.73	23
36224	7532	Earnhardt Dodge Auto Body	10.22	56	0.10	1	0.08	0
26	5082	Empire Machinery Co.	12.08	95	35.85	293	22.14	176
544	2451	Fleetwood Homes of Arizona Inc. #21	17.34	133				
27728	3674	Flipchip Technologies	10.91	60	0.30	2	0.25	1
1375	2511	Forest Designs	19.70	152				
779	2752	G & G Printers Inc.	4.84	37				
365	2653	Gaylord Container Corp.	12.26	68	2.37	18	1.99	15
41751	7534	GCR Truck Tire Center *	14.48	111				

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.

† = Point source is outside the nonattainment area.

Table 2-3 (continued). Annual and Ozone Season Day Emissions from All Point Sources (Alphabetical List)

ID #	SIC	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1437	3672	Hadco Phoenix Inc./ Sanmina Phx. Div. *	41.74	268	9.70	62	8.15	52
292	2834	Health Factors International Inc.	34.24	263	0.36	3	0.31	2
31565	3086	Henry Products Inc. *	55.88	516	0.47	4	0.39	4
1305	2752	Heritage Graphics Inc.	10.95	84				
138	2431	Heritage Shutters Inc.	13.15	101				
Pinal		Hexcel *†	701.45	4,570	15.79	125	12.55	90
40222	3663	Hexcel Satellite Products	0.05	0				
529	3086	Highland Products Inc. *	72.31	313	0.91	7	0.76	6
3536	2051	Holsum Bakery Inc. *	22.27	152	8.63	64	7.25	54
3802	2051	Holsum Bakery (Tempe)	19.80	161	1.10	8	0.92	7
1059	3724	Honeywell Aerospace Services	17.25	110	1.44	3	1.82	6
348	3812	Honeywell Air Transport Systems	22.75	125	0.46	3	0.38	2
247	3728	Honeywell Engines & Systems	6.80	37	2.58	14	2.17	12
355	3724	Honeywell International Inc.	63.57	401	76.55	421	31.36	172
1041	3769	Honeywell Satellite Systems Operations	6.69	51	0.62	4	0.52	3
354	3341	Imsamet of Arizona	0.43	2	18.40	101	94.17	517
1080	3679	Innovex Southwest Inc. *	11.10	61	1.18	8	0.99	7
777	3086	Insulfoam*	68.71	405	1.05	7	0.88	6
31617	3674	Intel Corp. Chandler Campus (Fab 6) *	28.86	162	10.11	128	7.31	53
3966	3674	Intel Corp. Ocotillo Campus (Fab 12)*	21.29	118	9.46	108	6.05	40
1483	3479	Interpipe Equipment Inc.	5.70	60				
790	3479	Intesys Technologies Inc.	25.05	202	0.37	3	0.31	2
654	2752	Ironwood Lithographers Inc.	9.63	74				
983	3679	Isola Laminate Systems Corp. *	80.55	516	34.78	223	12.94	83
813	2851	Kelly-Moore Paint Co. Inc. *	51.52	444				
788	2431	Kirkwood Shutters Ltd.	6.35	49				
341	3088	L & M Laminates and Marble	28.54	220				
4182	2511	Legends Furniture Inc.	80.12	616				
4360	2752	Litho Tech Inc.	10.19	78				
1276	7538	Lou Grubb Chevrolet	3.45	27				
3300	9711	Luke Air Force Base*	32.47	218	14.62	70	14.12	78
744	3325	M.E. West Castings Inc. *	30.44	237	8.99	61	47.67	363
1248	3088	Maax Spas	73.40	801				
4111	2512	Magic Woods Inc.	16.49	127				
205	2677	Mail-Well Envelope*	19.08	147	0.96	7	0.81	6
353	3089	Marlam Industries Inc.	41.37	318	0.04	0	0.01	0
62	2434	Mastercraft Cabinets Inc.	60.29	626	0.14	1	0.12	1
1382	2434	McCarthy Cabinet Co.	48.12	296				
971	3499	Mechtronics of Arizona Corp.	1.84	14				
1200	3674	Medtronic Microelectronics Center*	10.09	55				
3326	3281	Mesa Fully Formed Inc.	44.06	339				
1414	1442	Mesa Materials Inc.	9.45	87	42.43	392	15.99	148
83	3446	Metal-Weld Specialties Inc.	13.70	88				
192	2521	Meyer & Lundahl Manufacturing Co.	15.19	146				
1203	3674	Microchip Technology Inc. (Chandler) *	15.55	85	2.81	15	2.28	12
1875	3674	Microchip Technology Inc. (Tempe)*	39.07	217	3.18	40	2.24	17
176	3674	Microsemi Corp.	8.59	79				
226	3272	Monier Lifetile LLC	7.58	49	0.77	5	0.64	4
518	3672	Mosiac Printed Circuits Inc.	15.97	115				
881	3674	Motorola Inc. (Chandler) *	39.74	221	9.36	83	7.27	47
1109	3674	Motorola Inc. (Tempe)*	28.14	155	3.35	18	3.70	20

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.

† = Point source is outside the nonattainment area.

Table 2-3 (continued). Annual and Ozone Season Day Emissions from All Point Sources (Alphabetical List)

ID #	SIC	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1151	3674	Motorola Logic & Analog Tech Group*	96.80	535	11.51	102	16.80	101
223	3524	MTD Southwest Inc.	7.09	47	0.35	1	23.78	167
693	3585	Munters Corp.*	14.51	112	0.18	1	0.15	1
1190	2434	National Countertops & Cabinet	9.54	61				
36939	2834	Naturally Vitamin	7.92	61	0.05	0	0.04	0
826	3672	Nelco Technology Inc.*	97.73	751	2.29	13	1.92	11
948	3086	Nesco Manufacturing Inc.	11.89	91				
1309	2511	New Directions Inc.	30.62	236				
1878	8661	North Phoenix Baptist Church	0.56	4	13.57	104	1.96	15
3953	2434	Oakcraft Inc.	71.87	995	0.09	1	0.07	1
27925	2511	Oasis Bedroom Co.	10.65	82				
52382	4911	Ocotillo Power Plant	15.48	120	539.75	4,405	82.79	696
212	3674	ON Semiconductor*	99.91	554	18.17	232	12.47	87
3982	2752	O'Neil Printing Inc.	16.37	126				
1344	2451	Palm Harbor Homes Inc.	19.71	189				
98	4911	Palo Verde Nuclear Generating Station*†	30.03	173	49.05	270	20.96	115
733	7699	Pan-Glo West*	31.43	173	0.63	5	0.53	4
419	3724	Parker Hannifin GTFSD	32.15	247				
1398	3089	Patrician Marble Co. LLP	10.19	63				
1116	2431	Patrick Door Inc.	34.38	254				
1341	3949	Penn Racquet Sports*	289.15	1,854	4.81	31	4.04	26
1014	3251	Phoenix Brick Yard	13.47	101	11.71	64	39.31	216
69	3398	Phoenix Heat Treating Inc.	14.05	77	1.41	8	1.18	6
562	2711	Phoenix Newspapers Inc.	11.62	64	0.23	4	0.15	1
30171	4111	Phoenix Transit System	7.34	40	0.45	2	0.38	2
4050	2051	Pillsbury Bakeries & Food Service	11.96	88	0.51	4	0.43	3
1154	3449	Ping Inc.	7.43	57	0.20	0	0.17	0
4007	3479	Precision Truck Painting & Repair Inc.	11.48	88				
148	3369	Presto Casting Co.	12.36	95	0.78	6	0.59	5
1030	2752	Quebecor World - Phoenix Div.*	54.33	300	1.42	8	31.97	180
991	3479	Randall's VIP Trailers Inc.	7.52	58				
1503	2451	Redman Homes Inc.	21.63	166				
3773	3089	Redstone Industries Inc.*	3.15	29				
303	3411	Rexam Beverage Can Co.*	89.09	489	4.57	25	3.84	21
545	3672	Rockford Corp.	6.86	53				
508	2511	Samuel Lawrence Furniture Co.	64.82	499	0.03	0	0.02	0
3315	4911	Santan Generating Plant	3.63	32	1,356.64	12,231	336.71	3,024
266	3441	Schuff Steel Co.	17.90	115	0.21	1	0.18	1
246	2451	Schult Homes †	23.07	185				
4278	2431	Scottsdale Shutters Inc.	6.33	49				
207	3732	Sea Ray Boats	148.94	1,248				
4175	4226	SFPP LP	48.76	268	3.90	21	5.51	30
Pinal		Sierra Estrella Landfill†	16.00	88				
27933	4953	Skunk Creek Landfill	33.87	186	1.97	11	1.97	11
3316	4911	SRP Agua Fria	31.42	216	1,177.51	8,772	488.74	3,545
3317	4911	SRP Kyrene Steam Plant	1.86	27	124.58	1,599	39.03	529
4131	3674	ST Microelectronics	24.20	133	3.27	18	2.75	15
582	2511	Stone Creek Inc.	19.11	147				
388	3086	Storopack Inc.	8.94	69	0.16	1	0.13	1
27	3632	Sub Zero Freezer Co. Inc.*	27.17	187	0.84	3	0.76	3

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.

† = Point source is outside the nonattainment area.

Table 2-3 (continued). Annual and Ozone Season Day Emissions from All Point Sources (Alphabetical List)

ID #	SIC	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1463	2431	Sunburst Shutters Inc.	8.75	70				
101	2011	Sunland Beef Co. *	24.69	158	11.37	66	8.91	51
3691	5171	Supreme Oil Co. *	7.79	40				
40236	2752	Team Forms	10.15	78				
3978	2511	Team Two Design Associates Inc.	21.58	166				
1333	7997	Ted Levine Drum Co.	14.30	110	0.22	2	0.19	1
3444	5171	Texaco Phoenix Sales Terminal	47.98	124	0.35	2	0.30	2
249	3721	The Boeing Company	27.29	210	1.86	14	1.82	14
937	3799	The Heil Co.	9.92	76				
232	7011	The Phoenician Resort	13.69	76	50.47	277	33.06	182
552	2511	Thornwood Furniture Manufacturing	57.81	445				
363	2511	Thunderbird Furniture	23.28	179				
3443	5171	Tosco Phoenix Terminal	9.96	121				
532	2761	Trade Printers Inc.	10.65	102				
782	3471	Treffers Precision Inc.	6.22	48				
1210	2511	Trendwood Inc. (University Ave.)	44.18	340				
1211	2511	Trendwood Inc. (15th Ave.)	67.08	516				
169	7538	U-Haul Intl. Technical Center	12.62	81				
1228	3087	Ultra Installations Inc.	15.27	117				
234	2023	United Dairymen of Arizona	2.43	13	31.60	166	26.79	139
201	1442	United Metro Materials Inc. Plant #1	4.27	27	4.56	29	55.51	356
260	1442	United Metro Plant #11	15.65	136	10.02	80	16.03	141
213	1442	United Metro Plant #12	13.30	99	9.29	68	15.02	111
89	2452	United Modular	13.52	104				
827	3479	Valley Industrial Painting	10.26	79				
403	3354	VAW of America Inc. *	37.20	238	17.02	109	11.88	76
2	2951	Vulcan Materials Co. Western Div.	1.44	12	5.59	43	2.53	19
174	2899	W.R. Meadows of AZ Inc.	146.94	2,588	0.18	2	0.15	2
1149	2431	Weaver Quality Shutters Inc.	1.89	14				
376	2671	Western Packaging	6.78	52				
4384	2431	Western Shutter LLC	19.04	146				
2701	5171	Western States Petroleum #107*	14.67	81				
20706	3086	WinCup Holdings Inc. *	100.33	617	13.50	83	11.34	70
3324	2752	Woods Lithgraphics Inc.	15.31	98				
72	2511	Woodstuff Manufacturing Inc.	384.74	2,960	0.16	1	0.13	1
70	3069	Wynn's Precision Inc.	14.91	115				
		Totals:	5,948.67	43,914	5,473.70	42,123	1,789.15	13,098

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.

† = Point source is outside the nonattainment area.

Table 2-4. Annual and Ozone Season Day Emissions from All Point Sources, by Category

Tier II Code 0102: Electric Utilities – Fuel Combustion: Fuel Oil

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
3313	APS West Phoenix Power Plant	0.00	0	0.30	2	0.07	0
52382	Ocotillo Power Plant	0.01	0	0.18	4	0.04	1
3316	SRP Agua Fria	0.00	0	0.06	0	0.01	0
3317	SRP Kyrene Steam Plant	0.20	2	12.25	143	1.30	15
	0102 Total	0.21	2	12.79	148	1.43	16

Tier II Code 0103: Electric Utilities – Fuel Combustion: Natural Gas

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
52382	Ocotillo Power Plant	14.01	109	454.74	3,551	61.14	477
3316	SRP Agua Fria	29.31	204	1,012.74	7,048	447.71	3,116
3317	SRP Kyrene Steam Plant	1.50	23	51.72	804	22.86	356
	0103 Total	44.82	337	1,519.20	11,402	531.72	3,949

Tier II Code 0105: Electric Utilities – Fuel Combustion: Internal Combustion

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
3313	APS West Phoenix Power Plant	23.13	151	1,429.88	9,326	100.93	693
52382	Ocotillo Power Plant	0.55	6	84.83	851	21.61	218
98	Palo Verde Nuclear Generating Station †	0.00	0	0.26	1	0.03	0
3315	Santan Generating Plant	3.06	29	1,356.64	12,231	336.71	3,024
3316	SRP Agua Fria	0.36	4	164.77	1,724	41.01	429
3317	SRP Kyrene Steam Plant	0.16	2	60.61	652	14.86	159
	0105 Total	27.26	192	3,096.99	24,786	515.15	4,523
	Electric Utilities – Fuel Combustion Total	**72.29**	**530**	**4,628.98**	**36,336**	**1,048.29**	**8,488**

Tier II Code 0202: Industrial – Fuel Combustion: Fuel Oil

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
3966	Intel Corp. Ocotillo Campus (Fab 12)	0.04	2	1.72	66	0.22	8
1414	Mesa Materials Inc.	0.10	1	7.88	73	1.97	18
1203	Microchip Technology Inc. (Chandler)	0.01	0	0.14	0	0.03	0
212	ON Semiconductor	0.00	0	0.03	1	0.01	0
260	United Metro Plant #11	0.01	0	1.13	0	0.28	0
213	United Metro Plant #12	0.01	0	0.94	6	0.23	2
	0202 Total	0.18	3	11.83	145	2.74	28

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.
† = Point source is outside the nonattainment area.

Table 2-4 (continued). Annual and Ozone Season Day Emissions from All Point Sources, by Category

Tier II Code 0203: Industrial – Fuel Combustion: Natural Gas

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
35541	Allied Tube & Pipe Conduit Corp.	0.02	0	0.41	3	0.34	2
199	Ameron Pipe	0.03	0	0.57	4	0.48	4
1418	B.F. Goodrich Aircraft Evacuation Sys.	0.02	0	0.36	0	0.30	0
18	Belden Communications Division	0.22	2	3.95	30	3.31	25
3442	Caljet / Williams	0.00	0	0.00	0	1.53	8
1310	Century Graphics LLC *	0.00	0	0.08	1	0.07	2
1426	Cesar Color Inc.	0.00	0	0.02	0	0.02	0
1074	City of Phoenix 23rd Ave. WWTP	0.01	0	0.14	0	0.12	0
1054	Copperstate Cabinet Co. Inc.	0.00	0	0.01	0	0.01	0
31570	Copperstate Rubber of Arizona	0.01	0	0.20	1	0.17	1
1198	Courier Graphics Corp.	0.02	0	0.27	2	0.23	2
130	Dolphin Inc.	0.18	1	3.25	27	2.73	23
26	Empire Machinery Co.	0.10	1	1.73	13	1.45	11
27728	Flipchip Technologies	0.02	0	0.30	2	0.25	1
365	Gaylord Container Corp.	0.13	1	2.37	18	1.99	15
1437	Hadco Phoenix Inc./ Sanmina Phx. Div.	0.53	3	9.70	62	8.15	52
292	Health Factors International Inc.	0.02	0	0.36	3	0.31	2
31565	Henry Products Inc.	0.03	0	0.47	4	0.39	4
Pinal	Hexcel †	0.65	4	13.65	102	10.76	78
529	Highland Products Inc.	0.05	0	0.91	7	0.76	6
3802	Holsum Bakery (Tempe)	0.06	0	1.10	8	0.92	7
3536	Holsum Bakery Inc.	0.47	4	8.63	64	7.25	54
1059	Honeywell Aerospace Services	0.06	0	1.00	0	0.84	0
348	Honeywell Air Transport Systems	0.03	0	0.46	3	0.38	2
247	Honeywell Engines & Systems	0.14	1	2.58	14	2.17	12
355	Honeywell International Inc.	0.39	2	7.11	39	5.97	33
1041	Honeywell Satellite Systems Operations	0.03	0	0.62	4	0.52	3
1080	Innovex Southwest Inc.	0.07	0	1.18	8	0.99	7
777	Insulfoam	0.06	0	1.05	7	0.88	6
31617	Intel Corp. Chandler Campus (Fab 6)	0.45	2	8.12	36	6.82	31
3966	Intel Corp. Ocotillo Campus (Fab 12)	0.26	1	7.74	43	5.83	32
790	Intesys Technologies Inc.	0.02	0	0.37	3	0.31	2
983	Isola Laminate Systems Corp. *	0.10	1	1.19	8	1.00	6
744	M.E. West Castings Inc.	0.35	2	6.33	41	5.31	34
205	Mail-Well Envelope	0.05	0	0.96	7	0.81	6
62	Mastercraft Cabinets Inc.	0.01	0	0.14	1	0.12	1
1203	Microchip Technology Inc. (Chandler)	0.15	1	2.67	15	2.25	12
1875	Microchip Technology Inc. (Tempe)	0.14	1	2.49	13	2.09	11
226	Monier Lifetile LLC	0.04	0	0.77	5	0.64	4
881	Motorola Inc. (Chandler)	0.46	3	8.41	46	7.06	39
1109	Motorola Inc. (Tempe)	0.24	1	3.35	18	3.70	20
1151	Motorola Logic & Analog Tech Group	1.08	6	10.34	57	16.55	91
223	MTD Southwest Inc.	0.02	0	0.29	0	0.06	0
693	Munters Corp.	0.01	0	0.18	1	0.15	1
36939	Naturally Vitamin	0.00	0	0.05	0	0.04	0
826	Nelco Technology Inc.	0.13	1	2.29	13	1.92	11
3953	Oakcraft Inc.	0.00	0	0.09	1	0.07	1
212	ON Semiconductor	0.78	4	14.17	78	11.90	65
733	Pan-Glo West	0.03	0	0.63	5	0.53	4
1341	Penn Racquet Sports	0.27	2	4.81	31	4.04	26

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.

† = Point source is outside the nonattainment area.

Table 2-4 (continued). Annual and Ozone Season Day Emissions from All Point Sources, by Category

Tier II Code 0203: Industrial – Fuel Combustion: Natural Gas (continued)

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1014	Phoenix Brick Yard	0.00	0	0.06	0	0.05	0
69	Phoenix Heat Treating Inc.	0.08	0	1.41	8	1.18	6
4050	Pillsbury Bakeries & Food Service	0.03	0	0.51	4	0.43	3
1154	Ping Inc.	0.01	0	0.20	0	0.17	0
148	Presto Casting Co.	0.04	0	0.71	5	0.59	5
1030	Quebecor World - Phoenix Div.	0.08	0	1.42	8	31.97	180
303	Rexam Beverage Can Co.	0.25	1	4.57	25	3.84	21
508	Samuel Lawrence Furniture Co.	0.00	0	0.03	0	0.02	0
266	Schuff Steel Co.	0.01	0	0.21	1	0.18	1
4175	SFPP LP	0.60	3	3.90	21	5.51	30
4131	ST Microelectronics	0.18	1	3.27	18	2.75	15
388	Storopack Inc.	0.01	0	0.16	1	0.13	1
27	Sub Zero Freezer Co. Inc. *	0.03	0	0.84	3	0.76	3
101	Sunland Beef Co.	0.59	3	11.37	66	8.91	51
1333	Ted Levine Drum Co.	0.01	0	0.22	2	0.19	1
3444	Texaco Phoenix Sales Terminal	0.02	0	0.35	2	0.30	2
234	United Dairymen of Arizona	1.75	9	31.60	166	26.79	139
201	United Metro Materials Inc. Plant #1	0.03	0	0.51	3	0.43	3
260	United Metro Plant #11	0.05	0	0.84	8	0.71	6
213	United Metro Plant #12	0.04	0	0.79	6	0.66	5
403	VAW of America Inc.	0.59	4	16.84	108	9.08	58
2	Vulcan Materials Co. Western Div.	0.00	0	0.04	0	0.04	0
174	W.R. Meadows of AZ Inc.	0.01	0	0.18	2	0.15	2
20706	WinCup Holdings Inc.	0.72	4	13.50	83	11.34	70
72	Woodstuff Manufacturing Inc.	0.01	0	0.16	1	0.13	1
	0203 Total	13.06	77	231.48	1,389	230.76	1,362

Tier II Code 0204: Industrial – Fuel Combustion: Other Fuel

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
245	A.F. Lorts Co. Inc.	0.00	0	0.01	0	0.00	0
1059	Honeywell Aerospace Services	1.39	9	0.44	3	0.99	6
355	Honeywell International Inc.	5.83	32	69.44	382	25.39	139
353	Marlam Industries Inc.	0.00	0	0.04	0	0.01	0
98	Palo Verde Nuclear Generating Station †	0.77	4	1.80	10	7.04	39
	0204 Total	8.00	45	71.73	395	33.42	185

Tier II Code 0205: Industrial – Fuel Combustion: Internal Combustion

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1075	91st Ave. Wastewater Treatment Plant	0.01	0	0.14	3	0.03	1
1418	B.F. Goodrich Aircraft Evacuation Sys.	0.14	1	0.92	7	2.08	14
18	Belden Communications Division	0.02	0	0.26	2	0.06	0
1074	City of Phoenix 23rd Ave. WWTP	10.16	56	175.83	1,160	23.09	87
40233	City of Scottsdale Water Services Division	3.59	20	8.20	45	11.49	63
26	Empire Machinery Co.	7.24	58	34.12	280	20.68	165
31617	Intel Corp. Chandler Campus (Fab 6)	0.09	4	1.99	92	0.49	23

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.

† = Point source is outside the nonattainment area.

Table 2-4 (continued). Annual and Ozone Season Day Emissions from All Point Sources, by Category

Tier II Code 0205: Industrial – Fuel Combustion: Internal Combustion (continued)

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
3300	Luke AFB	0.00	0	0.60	5	0.56	4
1875	Microchip Technology Inc. (Tempe)	0.06	2	0.69	27	0.15	6
881	Motorola Inc. (Chandler)	0.08	3	0.95	36	0.20	8
1151	Motorola Logic & Analog Tech Group	0.08	3	1.17	45	0.25	10
223	MTD Southwest Inc.	4.40	30	0.04	0	23.70	167
212	ON Semiconductor	0.16	6	3.98	153	0.56	21
98	Palo Verde Nuclear Generating Station †	0.30	2	2.76	15	2.10	12
	0205 Total	26.33	186	231.66	1,870	85.45	579
	Industrial – Fuel Combustion Total	**47.56**	**311**	**546.70**	**3,799**	**352.38**	**2,153**

Tier II Code 0302: Other Fuel Combustion: Commercial/ Institutional Fuel Oil

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
98	Palo Verde Nuclear Generating Station †	1.13	6	44.23	243	11.79	65
	0302 Total	1.13	6	44.23	243	11.79	65

Tier II Code 0303: Other Fuel Combustion: Commercial/ Institutional Natural Gas

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
961	Big Surf	0.31	5	7.52	127	1.06	18
36224	Earnhardt Dodge Auto Body	0.01	0	0.10	1	0.08	0
3300	Luke Air Force Base	0.33	1	6.02	13	5.06	11
223	MTD Southwest Inc.	0.00	0	0.02	0	0.02	0
1878	North Phoenix Baptist Church	0.56	4	13.57	104	1.96	15
562	Phoenix Newspapers Inc.	0.01	0	0.23	4	0.15	1
30171	Phoenix Transit System	0.02	0	0.45	2	0.38	2
249	The Boeing Company	0.10	1	1.86	14	1.56	12
232	The Phoenician Resort	13.32	73	50.47	277	33.06	182
	0303 Total	14.66	84	80.23	543	43.31	241

Tier II Code 0304: Other Fuel Combustion: Miscellaneous Fuel Combustion

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
3300	Luke Air Force Base	10.37	79	7.57	49	8.24	62
	0304 Total	10.37	79	7.57	49	8.24	62
	Other Fuel Combustion Total	**26.15**	**170**	**132.03**	**835**	**63.35**	**368**

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.

† = Point source is outside the nonattainment area.

Table 2-4 (continued). Annual and Ozone Season Day Emissions from All Point Sources, by Category

Tier II Code 0403: Chemical & Allied Manufacturing: Polymer & Resin

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
Pinal	Hexcel *†	124.95	806	1.29	17	1.08	7
40222	Hexcel Satellite Products	0.01	0				
	0403 Total	124.96	806	1.29	17	1.08	7

Tier II Code 0405: Chemical & Allied Manufacturing: Paints, Varnishes, Lacquers, Enamels

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
813	Kelly-Moore Paint Co. Inc. *	51.52	444				
	0405 Total	51.52	444				

Tier II Code 0406: Chemical & Allied Manufacturing: Pharmaceuticals

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
36939	Naturally Vitamin	7.92	61				
	0406 Total	7.92	61				
	Chemical & Allied Manufacturing Total	**184.40**	**1,311**	**1.29**	**17**	**1.08**	**7**

Tier II Code 0501: Metals Processing: Non-Ferrous Processing

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
354	Imsamet of Arizona	0.43	2	18.40	101	94.17	517
148	Presto Casting Co.	0.08	1	0.08	1		
403	VAW of America Inc.	2.62	17	0.19	1	2.80	18
	0501 Total	3.12	20	18.66	103	96.97	535

Tier II Code 0502: Metals Processing: Ferrous Metals Processing

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
130	Dolphin Inc.	10.34	86	0.02	0		
744	M.E. West Castings Inc. *	24.15	188	2.66	21	42.36	328
69	Phoenix Heat Treating Inc.	13.91	76				
	0502 Total	48.41	350	2.68	21	42.36	328

Tier II Code 0503: Metals Processing: Other

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
744	M.E. West Castings Inc. *	5.89	47				
69	Phoenix Heat Treating Inc.	0.06	0				
148	Presto Casting Co.	4.34	33				
	0503 Total	10.29	81				
	Metals Processing Total	61.82	451	21.34	124	139.33	864

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.

† = Point source is outside the nonattainment area.

Table 2-4 (continued). Annual and Ozone Season Day Emissions from All Point Sources, by Category

Tier II Code 0701: Other Industrial Processes: Agriculture, Food & Kindred Products

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
292	Health Factors International Inc.	34.22	263				
3802	Holsum Bakery (Tempe)	19.74	152				
3536	Holsum Bakery Inc. *	21.80	158				
4050	Pillsbury Bakeries & Food Service	11.93	88				
101	Sunland Beef Co. *	19.29	124				
234	United Dairymen of Arizona	0.46	3				
	0701 Total	107.44	787				

Tier II Code 0702: Other Industrial Processes: Textiles, Leather & Apparel Products

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
101	Sunland Beef Co.	3.27	21				
	0702 Total	3.27	21				

Tier II Code 0703: Other Industrial Processes: Wood, Pulp, Paper, & Publishing Products

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1248	Maax Spas	5.56	60				
693	Munters Corp. *	14.50	112				
	0703 Total	20.07	171				

Tier II Code 0704: Other Industrial Processes: Rubber & Miscellaneous Plastic Products

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
43135	Arizona Pacific Spas	14.55	134				
18	Belden Communications Division	1.38	11				
31570	Copperstate Rubber of Arizona	5.18	43				
529	Highland Products Inc. *	72.26	312				
777	Insulfoam *	68.65	405				
341	L & M Laminates and Marble	28.54	220				
1248	Maax Spas	62.58	674				
353	Marlam Industries Inc.	5.55	43				
388	Storopack Inc.	8.93	69				
1228	Ultra Installations Inc.	15.27	117				
20706	WinCup Holdings Inc. *	92.56	570				
	0704 Total	375.45	2,597				

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.

† = Point source is outside the nonattainment area.

Table 2-4 (continued). Annual and Ozone Season Day Emissions from All Point Sources, by Category (continued)

Tier II Code 0705: Other Industrial Processes: Mineral Products

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
226	Monier Lifetile LLC	0.76	5				
1014	Phoenix Brick Yard	1.40	8	11.65	64	39.26	216
201	United Metro Materials Inc. Plant #1	2.75	18	4.05	26	55.08	353
260	United Metro Plant #11	13.70	123	8.06	72	15.04	135
213	United Metro Plant #12	12.86	96	7.56	56	14.12	105
2	Vulcan Materials Co. Western Div.	1.27	10	5.55	43	2.49	19
	0705 Total	32.74	259	36.87	261	125.99	828

Tier II Code 0707: Other Industrial Processes: Electronic Equipment

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1080	Innovex Southwest Inc. *	8.22	45				
3966	Intel Corp. Ocotillo Campus (Fab 12) *	20.98	115				
1203	Microchip Technology Inc. (Chandler) *	0.22	1				
176	Microsemi Corp.	6.20	57				
518	Mosiac Printed Circuits Inc.	15.97	115				
	0707 Total	51.60	334				

Tier II Code 0710: Other Industrial Processes: Miscellaneous Industrial Processes

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
199	Ameron Pipe	15.99	123				
25621	CMC Wireless Component	4.79	38				
130	Dolphin Inc.	0.06	0				
31565	Henry Products Inc. *	55.64	514				
Pinal	Hexcel *†	0.04	2	0.01	0	0.01	0
1080	Innovex Southwest Inc.	0.03	0				
1248	Maax Spas	4.06	55				
212	ON Semiconductor *	98.89	543				
98	Palo Verde Nuclear Generating Station †	3.93	22				
1341	Penn Racquet Sports *	288.89	1,852				
	0710 Total	472.35	3,148	0.01	0	0.27	2
	Other Industrial Processes Total	**1,062.88**	**7,318**	**36.88**	**262**	**126.26**	**830**

Tier II Code 0801: Solvent Utilization: Degreasing

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1075	91st Ave. Wastewater Treatment Plant	0.91	7				
199	Ameron Pipe	3.03	23				
3313	APS West Phoenix Power Plant	0.06	0				
18	Belden Communications Division	7.15	55				
1074	City of Phoenix 23rd Ave. WWTP	0.03	0				
130	Dolphin Inc.	0.62	5				
26	Empire Machinery Co.	0.41	3				

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.

† = Point source is outside the nonattainment area.

Table 2-4 (continued)**.** Annual and Ozone Season Day Emissions from All Point Sources, by Category

Tier II Code 0801: Solvent Utilization: Degreasing (continued)

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1437	Hadco Phoenix Inc./ Sanmina Phx. Div.	0.80	5				
31565	Henry Products Inc.	0.06	1				
1059	Honeywell Aerospace Services	15.14	97				
348	Honeywell Air Transport Systems	15.57	86				
247	Honeywell Engines & Systems	6.22	34				
355	Honeywell International Inc.	56.00	359				
983	Isola Laminate Systems Corp.	0.75	5				
3300	Luke Air Force Base	2.16	17				
971	Mechtronics of Arizona Corp.	0.36	3				
83	Metal-Weld Specialties Inc.	4.15	27				
176	Microsemi Corp.	0.20	2				
223	MTD Southwest Inc.	1.58	12				
52382	Ocotillo Power Plant	0.31	2				
98	Palo Verde Nuclear Generating Station †	1.85	10				
733	Pan-Glo West *	16.23	89				
419	Parker Hannifin GTFSD	3.23	25				
1014	Phoenix Brick Yard	11.88	91				
562	Phoenix Newspapers Inc.	0.88	5				
30171	Phoenix Transit System	3.44	19				
1154	Ping Inc.	0.07	1				
1503	Redman Homes Inc.	0.41	3				
3315	Santan Generating Plant	0.45	2				
266	Schuff Steel Co.	1.43	9				
3316	SRP Agua Fria	0.48	2				
27	Sub Zero Freezer Co. Inc.	13.82	84				
101	Sunland Beef Co.	1.55	10				
1333	Ted Levine Drum Co.	0.16	1				
249	The Boeing Company	19.09	147				
782	Treffers Precision Inc.	4.33	33				
169	U-Haul Intl. Technical Center	6.80	44				
234	United Dairymen of Arizona	0.22	1				
201	United Metro Materials Inc. Plant #1	0.52	3				
260	United Metro Plant #11	0.27	2				
213	United Metro Plant #12	0.03	0				
89	United Modular	1.85	14				
403	VAW of America Inc. *	33.99	218				
20706	WinCup Holdings Inc.	7.05	43				
70	Wynn's Precision Inc.	3.68	28				
	0801 Total	249.21	1,627				

Tier II Code 0802 Solvent Utilization: Graphic Arts

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
4028	B & D Litho Inc.	10.94	84				
36485	Billboard Poster Co. Inc.	22.76	210				
975	Buse Printing & Advertising	6.69	43				
1310	Century Graphics LLC *	11.04	85				

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.

† = Point source is outside the nonattainment area.

Table 2-4 (continued)**.** Annual and Ozone Season Day Emissions from All Point Sources, by Category

Tier II Code 0802 Solvent Utilization: Graphic Arts (continued)

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1426	Cesar Color Inc.	12.40	95				
1198	Courier Graphics Corp. *	12.69	88				
779	G & G Printers Inc.	4.84	37				
365	Gaylord Container Corp.	12.13	67				
31565	Henry Products Inc.	0.16	2				
1305	Heritage Graphics Inc.	10.95	84				
654	Ironwood Lithographers Inc.	9.63	74				
4360	Litho Tech Inc.	10.19	78				
205	Mail-Well Envelope *	19.03	146				
3982	O'Neil Printing Inc.	16.37	126				
562	Phoenix Newspapers Inc.	10.39	57				
1030	Quebecor World - Phoenix Div. *	54.26	299				
40236	Team Forms	10.15	78				
532	Trade Printers Inc.	10.65	102				
376	Western Packaging	6.78	52				
3324	Woods Lithgraphics Inc.	15.31	98				
	0802 Total	267.34	1,907				

Tier II Code 0804: Solvent Utilization: Surface Coating

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1330	A. Forzano & Son Inc.	7.15	48				
245	A.F. Lorts Co. Inc.	46.52	447				
1239	AG Products/American Gooseneck Inc.	15.31	100				
35541	Allied Tube & Pipe Conduit Corp.	12.33	114				
199	Ameron Pipe	5.81	45				
1476	Aspen Furniture LLC	108.04	798				
1331	Aspen II	55.55	427				
1418	B.F. Goodrich Aircraft Evacuation Sys.	69.84	537				
18	Belden Communications Division	14.93	115				
458	Bryant Industries Inc.	40.32	310				
40927	Case Products	10.21	79				
1316	Cavco Industries Inc. (Litchfield Rd.)	24.40	188				
1317	Cavco Industries Inc. (35th Ave.)	10.39	80				
1318	Cavco Industries Inc. (Durango St.)	31.58	243				
16	Cem-Tec Corporation	8.51	65				
1303	Chambers Belt Co. Inc.	5.78	44				
3976	Cholla Custom Cabinets Inc.	14.14	109				
4083	Chris Fischer Productions Inc.	14.41	133				
38731	Clayton Homes – El Mirage	11.36	87				
1054	Copperstate Cabinet Co. Inc.	8.89	68				
4023	Creative Shutters Inc.	13.62	84				
3744	Desert Sun Fiberglass Systems Ltd.	33.64	259				
130	Dolphin Inc.	0.13	1				
36224	Earnhardt Dodge Auto Body	10.22	56				
26	Empire Machinery Co.	3.10	24				
544	Fleetwood Homes of Arizona Inc. #21	17.34	133				
27728	Flipchip Technologies	10.89	60				

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.

† = Point source is outside the nonattainment area.

Table 2-4 (continued). Annual and Ozone Season Day Emissions from All Point Sources, by Category

Tier II Code 0804: Solvent Utilization: Surface Coating (continued)

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1375	Forest Designs	19.70	152				
41751	GCR Truck Tire Center	14.45	111				
1437	Hadco Phoenix Inc./Sanmina Phx. Div.*	40.40	259				
138	Heritage Shutters Inc.	13.15	101				
Pinal	Hexcel *†	563.91	3,674	0.22	2	0.19	1
40222	Hexcel Satellite Products	0.04	0				
1059	Honeywell Aerospace Services	0.66	4				
348	Honeywell Air Transport Systems	2.62	14				
247	Honeywell Engines & Systems	0.33	2				
355	Honeywell International Inc.	0.54	3				
1041	Honeywell Satellite Systems Operations	6.66	51				
1080	Innovex Southwest Inc.	2.78	15				
1483	Interpipe Equipment Inc.	5.70	60				
790	Intesys Technologies Inc.	25.03	202				
983	Isola Laminate Systems Corp. *	79.70	511	33.60	215	11.94	77
788	Kirkwood Shutters Ltd.	6.35	49				
4182	Legends Furniture Inc.	80.12	616				
1276	Lou Grubb Chevrolet	2.69	21				
3300	Luke Air Force Base *	2.74	21				
1248	Maax Spas	1.19	13				
4111	Magic Woods Inc.	16.49	127				
353	Marlam Industries Inc.	35.82	276				
62	Mastercraft Cabinets Inc.	60.28	626				
1382	McCarthy Cabinet Co.	48.12	296				
971	Mechtronics of Arizona Corp.	1.48	11				
1200	Medtronic Microelectronics Center *	10.09	55				
3326	Mesa Fully Formed Inc.	44.06	339				
83	Metal-Weld Specialties Inc.	9.56	61				
192	Meyer & Lundahl Manufacturing Co.	15.19	146				
1203	Microchip Technology Inc. (Chandler) *	13.73	75				
1875	Microchip Technology Inc. (Tempe) *	25.34	139				
176	Microsemi Corp.	2.19	20				
226	Monier Lifetile LLC	6.78	43				
881	Motorola Inc. (Chandler) *	39.20	215				
1109	Motorola Inc. (Tempe) *	27.60	152				
1151	Motorola Logic & Analog Tech Group *	92.70	509				
1190	National Countertops & Cabinet	9.54	61				
826	Nelco Technology Inc. *	97.41	749				
948	Nesco Manufacturing Inc.	11.89	91				
1309	New Directions Inc.	30.62	236				
3953	Oakcraft Inc.	71.87	995				
27925	Oasis Bedroom Co.	10.65	82				
1344	Palm Harbor Homes Inc.	19.71	189				
98	Palo Verde Nuclear Generating Station †	8.20	45				
733	Pan-Glo West *	15.16	83				
1398	Patrician Marble Co. LLP	10.19	63				
1116	Patrick Door Inc.	34.38	254				
30171	Phoenix Transit System	3.29	18				
1154	Ping Inc.	7.24	56				

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.

† = Point source is outside the nonattainment area.

Table 2-4 (continued). Annual and Ozone Season Day Emissions from All Point Sources, by Category

Tier II Code 0804: Solvent Utilization: Surface Coating (continued)

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
4007	Precision Truck Painting & Repair Inc.	11.48	88				
991	Randall's VIP Trailers Inc.	7.52	58				
1503	Redman Homes Inc.	14.10	108				
3773	Redstone Industries Inc.	0.31	3				
303	Rexam Beverage Can Co. *	88.83	488				
508	Samuel Lawrence Furniture Co.	64.81	499				
3315	Santan Generating Plant	0.08	0				
266	Schuff Steel Co.	16.20	104				
246	Schult Homes †	23.07	185				
4278	Scottsdale Shutters Inc.	6.33	49				
207	Sea Ray Boats	146.07	1,224				
3316	SRP Agua Fria	1.24	7				
582	Stone Creek Inc.	19.11	147				
27	Sub Zero Freezer Co. Inc. *	13.32	102				
1463	Sunburst Shutters Inc.	8.75	70				
3978	Team Two Design Associates Inc.	21.58	166				
1333	Ted Levine Drum Co.	14.14	109				
249	The Boeing Company	7.15	55				
937	The Heil Co.	9.92	76				
552	Thornwood Furniture Manufacturing	57.81	445				
363	Thunderbird Furniture	23.28	179				
782	Treffers Precision Inc.	1.89	15				
1210	Trendwood Inc. (University Ave.)	44.18	340				
1211	Trendwood Inc. (15th Ave.)	67.08	516				
169	U-Haul Intl. Technical Center	5.11	33				
89	United Modular	11.68	90				
827	Valley Industrial Painting	10.26	79				
1149	Weaver Quality Shutters Inc.	1.89	14				
4384	Western Shutter LLC	19.04	146				
72	Woodstuff Manufacturing Inc.	384.74	2,960				
70	Wynn's Precision Inc.	11.22	86				
	0804 Total	3,364.05	24,989	33.82	217	12.13	78

Tier II Code 0805: Solvent Utilization: Other Industrial

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
Pinal	Hexcel *†	11.89	84	0.61	4	0.51	3
348	Honeywell Air Transport Systems	4.54	25				
31617	Intel Corp. Chandler Campus (Fab 6) *	28.33	156				
1203	Microchip Technology Inc. (Chandler) *	1.44	8				
1875	Microchip Technology Inc. (Tempe) *	13.54	74				
826	Nelco Technology Inc.	0.20	2				
212	ON Semiconductor	0.07	0				
419	Parker Hannifin GTFSD	28.92	222				
562	Phoenix Newspapers Inc.	0.34	2				
148	Presto Casting Co.	7.90	61				
1503	Redman Homes Inc.	7.12	55				
3773	Redstone Industries Inc. *	2.85	26				

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.

† = Point source is outside the nonattainment area.

Table 2-4 (continued). Annual and Ozone Season Day Emissions from All Point Sources, by Category

Tier II Code 0805: Solvent Utilization: Other Industrial (continued)

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
545	Rockford Corp.	6.86	53				
4131	ST Microelectronics	24.02	132				
249	The Boeing Company	0.44	3				
174	W.R. Meadows of AZ Inc.	146.93	2,587				
	0805 Total	285.38	3,490	0.61	4	0.51	3

Tier II Code 0806: Solvent Utilization: Non-Industrial

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
98	Palo Verde Nuclear Generating Station †	3.42	26				
	0806 Total	3.42	26				
	Solvent Utilization Total	**4,169.41**	**32,040**	**34.43**	**221**	**12.64**	**81**

Tier II Code 0901: Storage & Transport: Bulk Terminals & Plants

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
3441	Arco Products Co. / Phoenix Terminal	22.63	116				
3528	Brown-Evans Distributing BP#1	10.34	84				
3442	Caljet / Williams	17.29	95				
3296	Calvert Oil Co. *†	12.72	72				
3297	Chevron USA Inc.	23.61	122				
4175	SFPP LP	48.16	265				
3691	Supreme Oil Co. *	7.30	37				
3444	Texaco Phoenix Sales Terminal	21.72	124				
3443	Tosco Phoenix Terminal	9.96	121				
2701	Western States Petroleum #107 *	13.87	76				
	0901 Total	187.59	1,113				

Tier II Code 0902: Storage & Transport: Petroleum & Petroleum Products Storage

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1075	91st Ave. Wastewater Treatment Plant	0.17	1				
199	Ameron Pipe	0.22	2				
3313	APS West Phoenix Power Plant	2.30	13				
18	Belden Communications Division	0.05	0				
3528	Brown-Evans Distributing BP#1	0.01	0				
3296	Calvert Oil Co. †	0.21	2				
996	Chapman Chevrolet-Isuzu Inc.	0.87	7				
247	Honeywell Engines & Systems	0.10	1				
355	Honeywell International Inc.	0.65	4				
1276	Lou Grubb Chevrolet	0.76	6				
3300	Luke Air Force Base	7.09	47				
744	M.E. West Castings Inc.	0.04	0				
223	MTD Southwest Inc.	1.10	5				
52382	Ocotillo Power Plant	0.60	3				

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.

† = Point source is outside the nonattainment area.

Table 2-4 (continued). Annual and Ozone Season Day Emissions from All Point Sources, by Category

Tier II Code 0902: Storage & Transport: Petroleum & Petroleum Products Storage

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
98	Palo Verde Nuclear Generating Station *†	8.80	48				
1014	Phoenix Brick Yard	0.18	1				
30171	Phoenix Transit System	0.58	3				
1154	Ping Inc.	0.11	1				
3315	Santan Generating Plant	0.04	0				
266	Schuff Steel Co.	0.26	2				
27933	Skunk Creek Landfill	0.59	3				
3316	SRP Agua Fria	0.03	0				
3317	SRP Kyrene Steam Plant	0.01	0				
3691	Supreme Oil Co.	0.49	3				
249	The Boeing Company	0.51	4				
232	The Phoenician Resort	0.37	2				
201	United Metro Materials Inc. Plant #1	0.96	6				
260	United Metro Plant #11	1.62	10				
213	United Metro Plant #12	0.36	2				
2	Vulcan Materials Co. Western Div.	0.17	2				
2701	Western States Petroleum #107 *	0.80	4				
	0902 Total	30.04	182				

Tier II Code 0904: Storage & Transport: Organic Chemical Storage

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
169	U-Haul Intl. Technical Center	0.71	5				
	0904 Total	0.71	5				

Tier II Code 0907: Storage & Transport: Organic Chemical Storage

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
355	Honeywell International Inc.	0.15	1				
207	Sea Ray Boats	2.86	24				
	0907 Total	3.01	25				

Tier II Code 0911: Storage & Transport: Bulk Materials Storage

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1414	Mesa Materials Inc.	9.35	86	34.55	319	14.02	129
	0911 Total	9.35	86	34.55	319	14.02	129
	Storage & Transport Total	**230.71**	**1,415**	**34.55**	**319**	**14.02**	**129**

Tier II Code 1003: Waste Disposal & Recycling: Publicly Owned Wastewater Treatment (POTW)

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1075	91st Ave. Wastewater Treatment Plant	1.65	9	30.01	170	25.21	142
1074	City of Phoenix 23rd Ave. WWTP	0.28	1	5.08	27	4.27	23
1151	Motorola Logic & Analog Tech Group	2.94	16				
	1003 Total	4.87	27	35.09	196	29.48	165

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.

† = Point source is outside the nonattainment area.

Table 2-4 (continued). Annual and Ozone Season Day Emissions from All Point Sources, by Category

Tier II Code 1005: Waste Disposal & Recycling: Treatment, Storage, Disposal Facilities

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1437	Hadco Phoenix Inc./ Sanmina Phx. Div.	0.02	0				
	1005 Total	0.02	0				

Tier II Code 1006: Waste Disposal & Recycling: Landfills

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
27933	Skunk Creek Landfill	33.28	183	1.97	11	1.97	11
Pinal	Sierra Estrella Landfill **	16.00	88				
	1006 Total	49.28	271	1.97	11	1.97	11

Tier II Code 1007: Waste Disposal & Recycling: Other

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
130	Dolphin Inc.	0.05	0				
3300	Luke Air Force Base *	9.79	54	0.43	3	0.26	2
	1007 Total	9.84	54	0.43	3	0.26	2
	Waste Disposal & Recycling Total	**64.00**	**352**	**37.49**	**210**	**31.71**	**177**

Tier II Code 1403: Miscellaneous: Catastrophic/Accidental Releases

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
3444	Texaco Phoenix Sales Terminal	26.24	0				
	1403 Total	26.24	0				

Tier II Code 1404: Miscellaneous: Repair Shops

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
26	Empire Machinery Co.	1.23	10				
	1404 Total	1.23	10				

Tier II Code 1406: Miscellaneous: Cooling Towers

ID #	Business Name	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
1109	Motorola Inc. (Tempe)	0.30	2				
98	Palo Verde Nuclear Generating Station †	1.64	9				
	1406 Total	1.93	11				
	Miscellaneous Processes Total	**29.40**	**20**				

Grand Total of All Categories

	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
Grand Total	**5,948.67**	**43,914**	**5,473.70**	**42,123**	**1,789.07**	**13,098**

* = Rule effectiveness (80 percent) has been applied to the emissions calculation.

† = Point source is outside the nonattainment area.

Table 2-5. Summary of Annual and Season Day Emissions from All Point Sources, by Tier Code Category

Tier code	Category	VOC tons/yr	VOC lbs/day	NOx tons/yr	NOx lbs/day	CO tons/yr	CO lbs/day
Electric Utilities – Fuel Combustion:							
0102	Fuel Oil	0.21	2	12.86	148	1.43	16
0103	Natural Gas	44.82	337	1,519.14	11,402	531.72	3,949
0105	Internal Combustion	27.26	191	3,096.99	24,786	515.15	4,523
	Subtotal	**72.29**	**530**	**4,628.99**	**36,336**	**1,048.29**	**8,488**
Industrial – Fuel Combustion:							
0202	Fuel Oil	0.18	3	11.83	145	2.74	28
0203	Natural Gas	13.06	77	231.48	1,389	230.76	1,362
0204	Other Fuel	8.00	45	71.73	395	33.42	185
0205	Internal Combustion	26.33	186	231.66	1,870	85.45	579
	Subtotal	**47.56**	**311**	**546.70**	**3,799**	**352.38**	**2,153**
Other Fuel Combustion: Commercial/ Institutional:							
0302	Fuel Oil	1.13	6	44.23	243	11.79	65
0303	Natural Gas	14.66	84	80.23	543	43.31	241
0304	Miscellaneous Fuel Combustion	10.37	79	7.57	49	8.24	62
	Subtotal	**26.15**	**170**	**132.03**	**835**	**63.35**	**368**
Chemical & Allied Manufacturing:							
0403	Polymer & Resin	124.96	806	1.29	17	1.08	7
0405	Paints, Varnishes, Lacquers, Enamels	51.52	444				
0406	Pharmaceuticals	7.92	61				
	Subtotal	**184.40**	**1,311**	**1.29**	**17**	**1.08**	**7**
Metals Processing:							
0501	Non-Ferrous Processing	3.12	20	18.66	103	96.97	535
0502	Ferrous Metals Processing	48.41	350	2.68	21	42.36	328
0503	Other	10.29	81				
	Subtotal	**61.82**	**451**	**21.34**	**124**	**139.33**	**864**
Other Industrial Processes:							
0701	Agriculture, Food & Kindred Products	107.44	787				
0702	Textiles, Leather & Apparel Products	3.27	21				
0703	Wood, Pulp, Paper, & Pub. Products	20.07	171				
0704	Rubber & Misc. Plastic Products	375.45	2,597				
0705	Mineral Products	32.74	259	36.87	261	125.99	828
0707	Electronic Equipment	51.60	334				
0710	Miscellaneous Industrial Processes	472.35	3,148	0.01	0	0.27	2
	Subtotal	**1,062.92**	**7,318**	**36.88**	**262**	**126.26**	**830**
Solvent Utilization:							
0801	Degreasing	249.21	1,627				
0802	Graphic Arts	267.34	1,907				
0804	Surface Coating	3,364.05	24,989	33.82	217	12.13	78
0805	Other Industrial	285.38	3,490	0.61	4	0.51	3
0806	Non-Industrial	3.42	26				
	Subtotal	**4,169.41**	**32,040**	**34.43**	**221**	**12.64**	**81**

Table 2-5 (continued). Summary of Annual and Season Day Emissions from All Point Sources, by Category

Tier code	Category	VOC tons/yr	VOC lbs/day	NOx tons/yr	NOx lbs/day	CO tons/yr	CO lbs/day
Storage & Transport:							
0901	Bulk Terminals & Plants	187.59	1,113				
0902	Petroleum & Petroleum Products Storage	30.04	182				
0904	Service Stations: Stage I	0.71	5				
0907	Organic Chemical Storage	3.01	25				
0911	Bulk Materials Storage	9.35	86	34.55	319	14.02	129
	Subtotal	**230.71**	**1,415**	**34.55**	**319**	**14.02**	**129**
Waste Disposal & Recycling:							
1003	Publicly Owned Treatment Works	4.87	27	35.09	196	29.48	165
1005	Treatment, Storage & Disposal Facilities	0.02	0				
1006	Landfills	49.28	271	1.97	11	1.97	11
1007	Other	9.84	54	0.43	3	0.26	2
	Subtotal	**64.00**	**352**	**37.49**	**210**	**31.71**	**177**
Miscellaneous:							
1403	Catastrophic/Accidental Releases	26.24	0				
1404	Repair Shops	1.23	9				
1406	Cooling Towers	1.93	11				
	Subtotal	**29.40**	**20**				
Grand Total:		**5,948.67**	**43,914**	**5,473.70**	**42,123**	**1,789.07**	**13,098**

Table 2-6. Summary of Annual and Season Day Point Source VOC Emissions by Category and Location

		Inside NAA		Outside NAA	
Tier Code	Category	VOC tons/yr	VOC lbs/day	VOC tons/yr	VOC lbs/day
Electric Utilities – Fuel Combustion:					
0102	Fuel Oil	0.21	2		
0103	Natural Gas	44.82	337		
0105	Internal Combustion	27.26	191		
Industrial – Fuel Combustion:					
0202	Fuel Oil	0.18	3		
0203	Natural Gas	12.41	69	0.65	4
0204	Other Fuel	7.23	41	0.77	4
0205	Internal Combustion	25.03	184	0.30	2
Other Fuel Combustion: Commercial/ Institutional:					
0302	Fuel Oil			1.13	6
0303	Natural Gas	14.66	84		
0304	Miscellaneous Fuel Combustion	10.37	79		
Chemical & Allied Manufacturing:					
0403	Polymer & Resin	0.01	0	124.95	806
0405	Paints, Varnishes, Lacquers, Enamels	51.52	444		
0406	Pharmaceuticals	7.92	61		
Metals Processing:					
0501	Non-Ferrous Processing	3.12	20		
0502	Ferrous Metals Processing	48.41	350		
0503	Other	10.29	81		

Table 2-6 (cont'd.) Summary of Annual and Season Day Point Source VOC Emissions by Category and Location

Tier Code	Category	Inside NAA VOC tons/yr	Inside NAA VOC lbs/day	Outside NAA VOC tons/yr	Outside NAA VOC lbs/day
Other Industrial Processes:					
0701	Agriculture, Food & Kindred Products	107.44	787		
0702	Textiles, Leather & Apparel Products	3.27	21		
0703	Wood, Pulp, Paper, & Publishing Products	20.07	171		
0704	Rubber & Miscellaneous Plastic Products	375.45	2,597		
0705	Mineral Products	32.74	259		
0707	Electronic Equipment	51.60	334		
0710	Miscellaneous Industrial Processes	468.34	3,125	3.97	23
Solvent Utilization:					
0801	Degreasing	247.36	1,617	1.85	10
0802	Graphic Arts	267.34	1,907		
0804	Surface Coating	2,768.87	21,085	595.18	3,904
0805	Other Industrial	273.49	3,407	11.89	84
0806	Non-Industrial			3.42	26
Storage & Transport:					
0901	Bulk Terminals & Plants	174.87	1,041	12.72	72
0902	Petroleum & Petroleum Products Storage	21.03	133	9.01	50
0904	Service Stations: Stage I	0.71	5		
0907	Organic Chemical Storage	3.01	25		
0911	Bulk Materials Storage	9.35	86		
Waste Disposal & Recycling:					
1003	Publicly Owned Treatment Works (POTW)	4.87	27		
1005	Treatment, Storage and Disposal Facilities	0.02	0		
1006	Landfills	33.28	183	16.00	88
1007	Other	9.84	54		
Miscellaneous:					
1403	Catastrophic/Accidental Releases	26.24	0		
1404	Repair Shops	1.23	9		
1406	Cooling Towers	0.29	2	1.64	9
	Totals:	**5,165.19**	**38,825**	**783.48**	**5,089**

2.6 References for Section 2

Maricopa County Environmental Services Department, 1993. 1990 Base Year Carbon Monoxide Emission Inventory. August 1993.

Maricopa County Environmental Services Department, 1993. 1990 Base Year Ozone Emission Inventory. August 1993.

Maricopa County Environmental Services Department, 1996. 1993 Ozone Periodic Emission Inventory. August 1996.

Maricopa County Environmental Services Department, 1999. 1996 Ozone Periodic Emission Inventory. November 1999.

U. S. Environmental Protection Agency, 1995, et seq. Compilation of Air Pollutant Emission Factors, Vol. I & II, AP-42.

U.S. Environmental Protection Agency. Handbook for Criteria Pollutant Inventory Development: A Beginner's Guide for Point and Area Sources. EPA-454/R-99-037. September 1999.

SECTION 3. AREA SOURCES

3.1 Introduction and Scope

All area source categories contained in the EPA Procedures document (EPA, 1991b) and the Tier Code category table used in Section 2 for point sources, were evaluated for this Maricopa County nonattainment area periodic ozone emissions inventory. The 1996 Ozone Periodic Emission Inventory, documents from the US EPA Emission Inventory Improvement Program (EIIP), and the permit and emissions data in the MCESD's Environmental Management System (EMS) database were used to compile data on the presence of, and emissions from, the area source categories used in this inventory.

Table 3-1 lists all categories and indicates which are considered area sources. Categories that are included are found within this section under the category subsection named in Table 3-1. Source categories are labeled "insignificant" because there are no large production facilities and or very few small sources, and therefore emissions were not quantified. A summary of all area source emissions is included in Table 3-48.

Table 3-1. Area Source Categories

Category	Section
Fuel Combustion	**Section 3.3**
-Industrial	Section 3.3.1
Oil	-Section 3.3.1.1
Gas	-Section 3.3.1.2
-Other	Section 3.3.2
Commercial/Institutional Oil	All are point sources, included in Section 2
Commercial/Institutional Gas	Section 3.3.2
-Heating	-Section 3.3.2.1
-Stationary Internal Combustion	-Section 3.3.2.2
Residential Fuel Combustion	Section 3.3.3
-Residential Wood	-Section 3.3.3.2
-Residential Other	-Section 3.3.3.3
Industrial Processes	**Section 3.4**
Plastic Product Manufacture	Section 3.4.1
Pharmaceutical Manufacturing	Section 3.4.2
Agriculture, Food, & Kindred Products	Section 3.4.3
-Bakeries	-Section 3.4.3.1
-Breweries	-Insignificant
-Coffee Roasting	-Insignificant
-Grain Elevators	-Insignificant
-Meat Smokehouses	-Insignificant
Wood, Pulp & Paper, & Publishing Products	Section 3.4.4
Mineral Products	Section 3.4.5
Electronic Equipment	Section 3.4.6
Miscellaneous Industrial Processes	Section 3.4.7

Table 3-1 (cont'd). Area Source Categories

Category	Section
Solvent Utilization	**Section 3.5**
Degreasing	Section 3.5.1
-Cold Cleaning: Automotive Repair	-Section 3.5.1.1
-Manufacturing	-Section 3.5.1.2
Graphic Arts	Section 3.5.2
Dry Cleaning	Section 3.5.3
Surface Coating	Section 3.5.4
-Large Appliances	-Section 3.5.4.1
-Metal Coils, Sheets, and Strips	-Section 3.5.4.2
-Paper/Fabric	-Section 3.5.4.3
-Wood Furniture	-Section 3.5.4.4
-Factory Finished Wood	-Section 3.5.4.5
-Miscellaneous Finished Metals	-Section 3.5.4.6
-Plastic Products	-Section 3.5.4.7
-Marine	-Section 3.5.4.8
-Railroad Coatings	-Section 3.5.4.9
-Machinery and Equipment	-Section 3.5.4.10
-High Performance Maintenance Coating	-Section 3.5.4.11
-Other Special Purpose Coatings	-Section 3.5.4.12
-Metal Furniture	-Section 3.5.4.13
-Other	-Section 3.5.4.14
Non-industrial	Section 3.5.5
-Architectural Coatings	-Section 3.5.5.1
-Auto Refinishing	-Section 3.5.5.2
-Traffic Markings	-Section 3.5.5.3
Other Solvent Utilization	Section 3.5.6
-Asphalt Paving	-Section 3.5.6.1
-Consumer/Commercial Solvent Use	-Section 3.5.6.2
-Pesticide Application	-Section 3.5.6.3
-Other	-Section 3.5.6.4
Storage and Transport	**Section 3.6**
Petroleum & Petroleum Product Transport	Section 3.6.1
-Tank Truck Cleaning	-Section 3.6.1.1
-Tank Truck Unloading	-Section 3.6.1.2
-Tank Trucks in Transit	-Section 3.6.1.3
Service Stations: Stage II (Vehicle Refueling)	Section 3.6.2
Service Stations: Breathing & Emptying	Section 3.6.3
-Underground Tank Breathing Losses	-Section 3.6.3.1
Organic Chemical Storage	Section 3.6.4
Organic Chemical Transport	Section 3.6.4
Airport Refueling	Section 3.6.5
Local Storage (Airports)	Section 3.6.6
Bulk Materials Storage	Section 3.6.7
Bulk Materials Transport	Section 3.6.7
Waste Disposal and Recycling	**Section 3.7**
Incineration	Section 3.7.1
Open Burning	Section 3.7.2
-Burning of Agricultural Ditch Banks and Fence Rows	-Section 3.7.2.1

Table 3-1 (cont'd). Area Source Categories

Category	Section
Waste Disposal and Recycling cont'd	**Section 3.7**
-Burning of Tumbleweeds	-Section 3.7.2.2
-Burning of Trees	-Section 3.7.2.3
-Burning for Land Clearance	-Section 3.7.2.4
-Pest Prevention Burning	-Section 3.7.2.5
Publicly Owned Treatment Works	Section 3.7.3
Treatment, Storage and Disposal Facilities	Section 3.7.4
Landfills	Section 3.7.5
Other	Section 3
Miscellaneous	**Section 3.8**
Leaking Underground Storage Tanks	Section 3.8.1
Catastrophic/Accidental Releases	Section 3.8.2
-Emissions from Forest Fires	-Section 3.8.2.1
-Structure, Motor Vehicle, and Brush Fires	-Section 3.8.2.2
-Fire Fighting Training	-Section 3.8.2.3
Repair Shops	Section 3.8.3
Health Services	Section 3.8.4

3.2 Methodology and Approach

Maricopa County Environmental Services Department (MCESD) prepared the area source emission estimates for all area sources and provided quality assurance checks on all data. Area sources included in Section 3 are shown in Table 3-1.

EPA emission factor documents AP-42, The Factor Information REtrieval (FIRE version 6.23) software, EIIP documents, or the EPA Procedures document (EPA, 1991b) were used to quantify emissions. The approaches used to calculate the different area source emissions are described in each section. When available, source information was used to calculate emissions. Maricopa County obtained source information in three ways: 1) by reviewing annual emission reports (see Appendix 2-1 for example emission reporting forms); 2) by reviewing permit files and logs; and 3) by conducting surveys to gather specific information. Default emission factors (per capita-based or employee-based) were finally used with the scale-up method when no other reliable data existed. The procedures document and AP-42 are the primary sources of emission factors used to calculate emissions. County Business Patterns for 1999 was used to estimate the number of employees for certain industries (U.S. Census Bureau, 2000). When a range of employees was provided, for example 0-19 employees, the most conservative or maximum number provided was used.

Rule effectiveness, control efficiency, and rule penetration were considered in all calculations where applicable. A rule effectiveness (RE) default factor of 80% was applied to the tank truck unloading and local storage (Airport AV-Gas) categories. Control efficiency estimates of 50% for the categories tank truck unloading and local storage (Airport AV-Gas) are based on the Maricopa County Rule Effectiveness Study (May 2000) requiring 90% recovery from gasoline tank truck unloading. Rule penetration estimates the extent to which defined sources in a category are regulated. Rule penetration was applied to vehicle refueling emission estimates. For that section, rule effectiveness was assumed to be 90% (100% rule effectiveness plus a 10% failure rate of the units), rule penetration 98%, and control efficiency 95% based on conversations with Arizona's Weights and Measures (Arizona, 2001).

3.3 Fuel Combustion

External combustion includes burning in equipment such as boilers and other heating devices. Natural gas and fuel oil are the only fuels considered in the calculations of external combustion emissions. The principal fuel used in external combustion equipment in Maricopa County is natural gas. Some quantities of fuel oil, including blends and wastes, are used by electric power plants and some industrial sources. Wood is used in residential woodstoves and fireplaces in the winter only (not the ozone season), but is included for annual emissions calculations. No coal is used in the nonattainment area. Only a small amount of liquid petroleum gas (LPG) is used by external combustion sources, therefore, contribution to total emissions is considered to be insignificant and is not included.

To collect natural gas distribution data, Maricopa County Environmental Services Department (MCESD) contacted four natural gas companies, three of which are retail and one is wholesale. A list of all four natural gas companies, contacts, and distribution data is contained in Appendix 3-1. The data collected are used to estimate emissions by providing activity levels of natural gas used for the following stationary source categories: Industrial, Commercial/Institutional, and Residential.

Sales data from the wholesale distributor were obtained as a quality assurance check on the retail data. The wholesale distributor reported supplying the three retail suppliers with approximately 39.2 billion cubic feet of natural gas in 1999. This amount correlates with the total distribution to consumers reported by the three local retail companies (see Appendix 3-1). The difference can be explained by two factors: (1) identification of the nonattainment area by the respective companies was approximate; and (2) other small, non-commercial sources of natural gas are being utilized by the local natural gas retailers (e.g., the City of Mesa buys and sells digester gas from the City of Phoenix 91st Avenue Sewage Treatment Plant).

Each natural gas distribution company provided their seasonal distribution percentages based on the EPA-designated seasons of December–February, March–May, June–August, and September–November. The June–August data were used to estimate the total fuel consumption for the ozone season day emissions.

It is assumed that all natural gas sold is ultimately used in a combustion process, although each distribution company does lose a minimal amount to leakage, damaged lines, and venting of lines during repairs.

MCESD requested the four retail natural gas suppliers to provide distribution data showing the types of sources receiving the natural gas. This information allowed all sources to be categorized. Source categories in this part of the inventory are Industrial, Commercial/ Institutional, and Residential. The subsections below describe the procedures for estimating stationary area source external fuel combustion for these source categories.

3.3.1 Industrial Fuel Combustion

The following paragraphs describe the procedures for determining annual and daily industrial area source natural gas and fuel oil external combustion emissions. Tables 3-2 and 3-3 show annual and average daily ozone season emissions.

3.3.1.1 Industrial Area Source Fuel Oil Combustion

It is estimated that 5.45×10^6 gallons of diesel (Fuel Oil #2) and 2.46×10^6 gallons of #6 fuel oil were sold in Maricopa County in 1999. This is based on a review of all 1999 emission inventories, and includes an assumption that 5% of sold fuel oil is used by unpermitted sources. Emission factors for industrial boilers burning waste oil (blends) were obtained from Table 1.11-1 in AP-42, or from the FIRE database. Table 3-2 shows emission factors and emissions. Point source combustion (reported in Section 2) were subtracted from these totals, to derive area source fuel use estimates of diesel use (4,732,400 gal + 5% = 4,969,020 gals total) and fuel oil use (156,920 gal + 5% = 164,770 gal total).

Table 3-2. Annual and Season Day Emissions from Fuel Oil External Combustion

	Emission Factor (lb/1000 gallons)			VOC	VOC	NOx	NOx	CO	CO
Category / Pollutant	**VOC**	**NO_x**	**CO**	**tons/yr**	**tons/day**	**tons/yr**	**tons/day**	**tons/yr**	**tons/day**
Fuel oil in boilers (SCC 10200501)	0.2	24	5	0.02	0.00	1.98	0.01	0.41	0.00
Diesel in engines (SCC 20200102)	49.3	604	130	122.49	0.39	1,500.64	4.81	322.99	1.04
Totals:				**122.51**	**0.39**	**1,502.62**	**4.82**	**323.40**	**1.04**

The emission factor is multiplied by the total gallons of fuel oil sold to calculate emissions. For example:

NO_x emissions from fuel oil (lbs) = Total fuel sold (in 1000 gals) $\times$ NO_x emission factor (in lb/1000 gal)
= 164.770×24
= 3,954 lbs/yr
= 1.98 tons/yr

Since there are no local seasonal data, season day emissions are calculated based on information found in Table 5.8-1 of EPA guidance (EPA, 1990). This table indicates fossil fuel combustion for industrial area sources is uniform throughout the year and throughout a six-day week. Season day emissions are determined using the following formula:

$$\text{Average Daily Ozone Season } NO_x \text{ Emissions} = \frac{\text{Annual Emissions (lb)} \times \text{Seasonal Factor}}{\text{Operation (days/week)} \times \text{Season (weeks/year)}}$$

$$= \frac{3{,}954 \times 0.25}{6 \times 13}$$

= 12.7 lbs/day
= 0.01 tons/day

3.3.1.2 Industrial Area Source Natural Gas Combustion

Based on a review of annual emissions reports from permitted sources, virtually all natural gas consumption in 1999 was by large boilers (and similar heating equipment) and the amount consumed in engines was minimal. Total natural gas sales for the industrial user category is 10,016.1 million cubic feet:

Total usage – point source usage = Area source natural gas usage

10,016.1 MMCF – [4,062.2 MMCF (boilers) + 158.5 MMCF (engines)] =5,795.4 MMCF natural gas used

The ratio of internal to external combustion usage was assumed to be the same as in point sources. Area source natural gas usage was thus apportioned:

5,795.4 MMCF × 96% = 5,563.6 MMCF of natural gas was used for external combustion

5,795.4 MMCF × 4% = 231.8 MMCF of natural gas was used for internal combustion

External Combustion

This total for external combustion is multiplied by the appropriate emission factor to determine emissions for the year. MCESD chose the combustion rate category of $10–100 \times 10^6$ Btu/hr (SCC 10200602) as representative of industrial area source natural gas external combustion. Emission factors from AP-42 (EPA, 1998) were used. Table 3-3 shows emission factors and total 1999 and average daily ozone season emissions. For this calculation, it was assumed that area source industrial natural gas combustion occurred in boilers or heaters.

Table 3-3. Annual and Season Day Emissions from Natural Gas External Combustion

	Emission Factor (lb/MMCF)	Annual lbs/year	Annual tons/year	Season Day lbs/day	Season Day tons/day
VOC	5.5	30,600	15.30	94	0.05
NO_x	100.0	556,360	278.18	1,712	0.86
CO	84.0	467,341	233.67	1,438	0.72

A sample calculation of annual emissions is as follows:

1999 VOC emissions = (5,563.6 MMCF) × (5.5 lb/MMCF)
= 30,600 lbs/yr
= 15.3 tons/yr

The procedure for calculating average daily ozone season emissions for industrial natural gas external combustion is described below. The only natural gas suppliers to industry in 1999 were Southwest Gas Corporation and the City of Mesa Utilities Department. Total natural gas distribution was calculated by adding the Southwest Gas Corporation distribution in June-August of 2,222.2 MMCF to the 189.2 MMCF reported by the City of Mesa Utilities Department. The total natural gas consumption in June–August was 2,411.4 MMCF. The seasonal adjustment factor was determined as follows:

$$\text{Seasonal adjustment factor} = \frac{\text{June–August MMCF}}{\text{Total MMCF}} = \frac{2{,}411.4 \text{ MMCF}}{10{,}016.1 \text{ MMCF}} = 0.24$$

According to Table 5.8-1 of EPA guidance (EPA, 1990), fossil fuel use for industrial area sources occurs over a six-day week. Average daily ozone season emissions are determined as follows:

$$\text{Average Daily Ozone Season VOC emissions} = \frac{\text{Annual Emissions (lb)} \times \text{Seasonal Factor}}{\text{Operation (days/week)} \times \text{Season (weeks/year)}}$$

$$= \frac{30{,}600 \times 0.24}{6 \times 13}$$

= 94.2 lbs/day
= 0.05 tons/day

Internal Combustion

The procedures for calculating emissions from natural gas internal combustion were the same as for external combustion. However, MCESD chose SCC 20200202 as representative of industrial area source internal combustion (EPA, July 1998) with the following emission factors:

VOC: 116 lb/MMCF

NO_x: 2840 lb/MMCF

CO: 399 lb/MMCF

Multiplying the above emission factors by the 231.8 MMCF estimated natural gas burned with internal combustion engines for area sources, the following emissions in Table 3-4 were calculated. Using the same procedure for ozone season day emissions as was used for external combustion, those emissions are included in Table 3-4 as well.

Table 3-4. Annual and Season Day Emissions from Natural Gas Internal Combustion

	Annual lbs/year	**Annual tons/year**	**Season Day lbs/day**	**Season Day tons/day**
VOC	26,889	13.44	83	0.04
NO_x	658,312	329.16	2,026	1.01
CO	92,488	46.24	285	0.14

3.3.1.3 Summary of Area Source Industrial Fuel Combustion

Area source annual and average daily ozone season emissions from industrial combustion are presented in Table 3-5.

Table 3-5. Summary of Industrial Area Source Combustion Emissions

Fuel	**VOC tons/yr**	**VOC tons/day**	**NOx tons/yr**	**NOx tons/day**	**CO tons/yr**	**CO tons/day**
Fuel Oil	122.50	0.39	1,502.62	4.82	323.40	1.04
Natural Gas- External	15.30	0.05	278.18	0.86	233.67	0.72
Natural Gas- Internal	13.44	0.04	329.16	1.01	46.24	0.14
Totals:	**151.24**	**0.48**	**2,109.96**	**6.69**	**603.31**	**1.90**

3.3.2 Commercial/Institutional Fuel Combustion

This category of fuel consumption comprises natural gas burned in heating equipment and in both reciprocating and turbine engines. All other fuels are considered negligible. MCESD assumes that the natural gas usage of 14,202 million cubic feet reported as "Commercial" and "Other" was split equally between boilers (and similar heating equipment) and engines. This assumption is supported by review of the point source fuel- burning equipment fuel usage. Area source natural gas usage was calculated as:

Total usage – point source usage = Area source natural gas usage

14,202 – (244 + 163) = 13,795 MMCF area source usage

The ratio of internal to external combustion usage was assumed to be the same as in point sources. Area source natural gas usage was thus apportioned:

13,795 MMCF × 40.1% used in internal combustion engines = 5,531.8 MMCF

13,795 MMCF × 59.9% used in external combustion (boilers, etc.) = 8,263.2 MMCF

3.3.2.1 Stationary Area Source External Combustion Commercial/Institutional (Heating)

A total of 8,263.2 MMCF was estimated to be used in external combustion area sources. This total is multiplied by the emission factors from AP-42 to determine the annual emissions as in the example below.

1999 VOC Emissions from Commercial/Institutional Heating = 8,263.2 MMCF × 5.5 lb/MMCF
= 45,448 lbs/yr = 22.7 tons/yr

Table 3-6. Annual and Season Day Emissions from Natural Gas External Combustion: Commercial/Institutional Area Sources

	Emission Factor SCC 10300602 (lb/million cu ft)	**Annual emissions (lbs)**	**Annual emissions (tons)**	**Season day emissions (lbs)**	**Season day emissions (tons)**
VOC	5.5	45,448	22.72	116	0.06
NO_x	100.0	826,320	413.16	2,119	1.06
CO	84.0	694,109	347.05	1,780	0.88

Calculation of the ozone season emissions for commercial/institutional heating uses the June–August natural gas distribution figures as shown in Table 3-7.

Table 3-7. Suppliers and Distribution of Natural Gas to Commercial/Institutional Area Sources

Supplier	**Annual MMCF**	**June–Aug MMCF**
Southwest Gas Corp. to "Commercial"	12,467.6	2,550.1
City of Mesa to "Commercial"	1,621.0	308.0
Black Mountain Gas Co. to "Commercial"	113.5	20.4
Totals:	14,202.1	2,878.5

The total season consumption was divided by the total year consumption to determine seasonal adjustment factor for commercial/institutional heating, as follows:

$$\text{Seasonal adjustment factor} = \frac{\text{June-August MMCF}}{\text{Total MMCF}} = \frac{2{,}878.5 \text{ MMCF}}{14{,}202.1 \text{ MMCF}} = 0.20$$

According to Table 5.8-1 of EPA guidance (EPA, 1990), natural gas combustion in the commercial/ institutional category is equally distributed throughout a six-day week. The average daily ozone season emissions from heating are calculated according to the following example.

$$\text{Average Daily Ozone Season VOC Emissions} = \frac{\text{Annual Emissions (lb)} \times \text{Seasonal Factor}}{\text{Operation (days/week)} \times \text{Season (weeks/year)}}$$

$$= \frac{45{,}448 \text{ lb} \times 0.20}{6 \times 13}$$

$$= 116.5 \text{ lbs/day}$$

$$= 0.06 \text{ tons/day}$$

3.3.2.2 Commercial/Institutional Stationary Internal Combustion

Internal combustion engines are only used by commercial/institutional sources and electric utility sources (included in the point source section) in the Maricopa County nonattainment area. The only internal combustion engines are natural gas engines. Stationary internal combustion emissions are included to account for natural gas reciprocating and turbine engines used by area sources.

Reciprocating Engines

The ratio of reciprocating engines to turbines was assumed to be the same as in point sources. Therefore reciprocating engines were 54.4% of the total internal combustion engines. 54.4% was multiplied by the total 5531.8 MMCF, to get 3009.3 MMCF of natural gas used by area source reciprocating engines. 3009.3 MMCF was multiplied by the following averaged 2-cycle and 4-cycle lean burn emission factors (for CO and NO_x four emission factors, for VOC two) to calculate annual emissions, as shown in the example and Table 3-8 below.

Reciprocating engine factors converted from lb/MMBtu to lb/MMCF: (EPA, August 2000)

VOC emission factor = (123.9 + 126) / 2 = 125 lb/MMCF
NO_x emission factor = (3328.5 + 2037 + 4284 + 889.4) / 4 = 2635 lb/MMCF
CO emission factor = (405.3 + 370.6 + 332.8 + 584.8) / 4 = 423 lb/MMCF

Total 1999 VOC emissions = 3009.3 MMCF × 125 lb/MMCF = 376,163 lbs/yr = 188.08 tons/yr

Table 3-8. Annual and Season Day Emissions from Natural Gas Reciprocating Engines

	Emission Factor (lb/MMCF)	lbs/year	tons/year	lbs/day	tons/day
VOC	125	376,163	188.08	1,033	0.52
NO_x	2635	7,929,506	3,964.75	21,784	10.89
CO	423	1,272,934	636.47	3,497	1.75

Seasonal operations in this category were distributed over a seven-day week and assumed to be constant throughout the year. Therefore the average daily ozone season emissions are calculated as follows:

$$\text{Season Day VOC Emissions} = \frac{\text{Annual Emissions (lb)} \times \text{Seasonal Factor}}{\text{Operation (days/week)} \times \text{Season (weeks/year)}}$$

$$= \frac{376{,}163 \text{ lbs} \times 0.25}{7 \times 13} = 1{,}033 \text{ lb/day} = 0.52 \text{ tons/day}$$

Turbine Engines

Subtracting 3009.3 MMCF from 5531.8 MMCF, 2522.5 MMCF of natural gas was estimated as burned in turbine engines. The turbine emission factor was obtained from AP-42 (EPA, April 2000).

Total 1999 VOC emissions = 2,522.5 MMCF × 2.2 lb/MMCF = 5,550 lbs or 2.77 tons VOC/year
Total 1999 NO_x emissions = 2,522.5 MMCF × 336 LB/MMCF = 847,560 lbs or 423.78 tons NO_x/year
Total 1999 CO emissions = 2,522.5 MMCF × 84 lb/MMCF = 211,890 lbs or 105.94 tons CO/year

Table 3-9. Annual and Season Day Emissions from Natural Gas Turbine Engines

	Emission Factor (lb/MMCF)	lbs/yr	tons/yr	lbs/day	tons/day
VOC	2.2	5,550	2.77	15	0.01
NO_x	336	847,560	423.78	2,328	1.16
CO	84	211,890	105.94	582	0.29

The seasonal adjustment factor for natural gas combustion in turbine engines is 25%, the same as used for reciprocating engines. Seasonal operations in this category were distributed over a seven-day week. Therefore the season daily CO emissions are calculated as follows:

$$\text{Season Day VOC Emissions} = \frac{\text{Annual Emissions (lb)} \times \text{Seasonal Factor}}{\text{Operation (days/week)} \times \text{Season (weeks/year)}}$$

$$= \frac{5{,}550 \times 0.25}{7 \times 13} = 15.2 \text{ lb/day or } 0.01 \text{ tons/day}$$

Internal combustion area source emissions (both natural gas reciprocating and turbine engines) are shown in Table 3-10.

3.3.2.3 Summary of Commercial/ Institutional Area Source Combustion Emissions

Table 3-10. Summary of Commercial/ Institutional Area Source Combustion Emissions

Category	VOC tons/yr	VOC tons/day	NO_x tons/yr	NO_x tons/day	CO tons/yr	CO tons/day
External Combustion	22.72	0.06	413.16	1.06	347.05	0.88
Internal- Reciprocating	188.08	0.52	3,964.75	10.89	636.47	1.75
Internal- Turbine	2.77	0.01	423.78	1.16	105.94	0.29
Totals:	**213.57**	**0.59**	**4,801.69**	**13.11**	**1,089.46**	**2.92**

3.3.3 Residential Fuel Combustion

3.3.3.1 Emissions from Fireplaces and Wood Stoves

EPA emission factors for burning wood in fireplaces and wood stoves are given for tons of wood burned. To determine emissions during 1999 for the Maricopa County nonattainment area, MCESD kept constant the emissions that were estimated for 1996. This was done due to the Maricopa County Wood Burning Ordinance that had been put into place September 30, 1994. Although it was anticipated that the ordinance would create a decrease in emissions, there was no concrete evidence to draw data from. Therefore, it was concluded the most conservative course would be to assume the emissions stayed constant. For clarity, how emissions were calculated in the 1996 emission inventory is described below. A few minor errors were discovered in the 1996 inventory, and they were corrected to reflect more accurate emission estimations below. The method for estimating residential wood consumption described in the procedures document (EPA, May, 1991) was used to estimate CO emissions in this category.

Proportion of Residential Units with Wood-Burning Devices

Survey data collected in Maricopa County in 1996 was used to calculate emissions from residential woodburning (MAG, 1997). Of the 1,483 surveys, 461 or 31.1% reported having woodburning devices and 295 or 64% used wood. The survey purpose included gathering data on what types of wood are burned and wood-burning device activity.

Number of Fireplaces

According to the 1994 demographic data provided by MAG, there were 1,005,529 residential housing units in the Maricopa County nonattainment area. The survey in 1996 indicated that of the residences surveyed, there were 398 reported fireplaces out of 461 woodburning devices, or 86.3% (MAG, 1997). The number of residential fireplaces contributing emissions for 1999 is estimated using the following series of calculations:

Woodburning devices	= 1,005,529 (households) × 0.311 (fraction with woodburning devices)
	= 312,720 woodburning devices
Fireplaces	= 312,720 devices × 0.863 fireplaces
	= 269,877 fireplaces
Active Fireplaces	= 269,877 fireplaces × 0.641 (fraction that burns wood) = 172,991 active fireplaces

Number of Woodstoves

The number of wood stoves was determined similarly. Out of the 461 returned surveys that had woodburning devices, 16 (3.5% of all respondents) had woodstoves, and of these, 10 (62.5%) used them to burn wood. The number of residential woodstoves is estimated using the following series of calculations:

Woodburning devices	= 1,005,529 households × 0.311 fraction households with woodburning devices
	= 312,720 woodburning devices
Woodstoves	= 312,720 devices × 0.035
	= 10,945 woodstoves
Active Woodstoves	= 10,945 woodstoves × 0.625 (fraction that burns wood)= 6,841 active woodstoves

Number of Barbecue (BBQ) / Firepits

The number of BBQ/firepits was determined similarly. Out of the 461 returned surveys that had woodburning devices, 47 (10.2% of the total) had firepits, and of these, 30 (63.8%) used them to burn wood. The number of residential firepits is estimated using the following series of calculations:

# of Woodburning devices	= 1,005,529 houses × 0.311 fraction with woodburning devices
	= 312,720 woodburning devices
# of Firepits	= 312,720 devices × 0.102 fraction with firepits
	= 31,897
# of Active Firepits	= 31,897 firepits × 0.638 fraction that burns wood = 20,351

Density and Types of Wood Burned in Maricopa County

Types of wood burned in Maricopa County were also collected during the 1996 survey. Types of wood and the composite density were calculated from the information is provided in Table 3-11.

Table 3-11. Density of Wood Types Used in Wood-burning Devices in Maricopa County

Wood Types	Number of Uses from Survey	Composite Density (lb/ft^3)
Hardwood (Mesquite and Gambel Oak)	141	42.33
Softwood (Junipers and Ponderosa Pine)	105	29.48
Processed Logs	103	18.8
Miscellaneous (broken furniture and scrap - used density of Junipers and Ponderosa Pine)	13	31.6
Pellets	2	40
Weighted Average Density		**31.66**

The weighted average density was calculated as follows:

$$\text{Weighted Average Density} = \frac{(141 \times 42.33) + (105 \times 29.48) + (103 \times 18.8) + (13 \times 31.6) + (2 \times 40)}{364 \text{ total uses}}$$

$$= 31.57 \text{ lbs/ft}^3$$

The US Forest Service (USFS, 1993) provided MCESD with the following mix of tree species harvested for firewood in Arizona and sold in the Maricopa County area. The mix and composite wood density of the various types of wood burned in Maricopa County are shown in Table 3-12. Composite wood density (CWD) combines the percentage of each type of firewood and its density into a single factor. It is calculated according to the following formula: $CWD = \Sigma [(\%\text{ wood species } i) \times (\text{density } i)]$. The composite densities listed for hardwood and softwood are a weighted average of the densities listed in Table 3-12.

Table 3-12. Wood Mix and Composite Wood Density (CWD) for Wood Species Used for Firewood in Maricopa County

Tree Species	Percent of Total Wood Burned	Density (lb/ft^3)	Composite Wood Density (lb/ft^3)
Both Junipers (Mean)	60%	30.2	18.1
Ponderosa Pine	20%	26.3	5.3
Mesquite	10%	43.7	4.4
Gambel Oak	5%	39.6	2.0
Pinon Pine and other misc. species	5%	31.6	1.6

Volume and Quantity of Wood Burned in Maricopa County

The frequency and quantity of wood burned in fireplaces in the Maricopa County nonattainment area was also gathered in the 1996 survey (MAG, 1997). Survey respondents were asked the frequency they use their wood-burning devices and the number of logs burned for each use. Using the mean range of the survey results for an average, there are 11.3 uses per household per year and 3.1 logs are burned per use. The estimated number of cords of wood burned in residential fireplaces in the Maricopa County nonattainment area in 1999 was calculated as:

1999 Quantity of Wood Burned in Fireplaces = 172,991 active fireplaces $\times$ 11.3 uses/yr $\times$ 3.1 logs/use $\times$ 0.17 ft^3/log

$$= 1{,}030{,}179 \text{ ft}^3$$

1999 Mass of Wood Burned in Fireplaces = 1,030,179 $ft^3 \times 31.57$ lb/ft^3

$$= 32{,}522{,}751 \text{ lbs/yr}$$

$$= 16{,}261.38 \text{ tons/yr}$$

Similarly, the amount of wood burned in woodstoves was calculated. Using the mean range of the survey results for an average, there are 12.8 uses per household per year and 2.3 logs are burned per use.

1999 Quantity of Wood Burned in Woodstoves = 6,841 active woodstoves × 12.8 uses/yr × 2.3 logs/use × 0.17 ft^3/log

= 34,237 ft^3/yr

1999 Mass of Wood Burned in Woodstoves = 34,237 ft^3 × 31.57 lb/ft^3

= 1,080,862 lbs/yr

= 540.43 tons/yr

Similarly, the amount of wood burned in firepits was calculated. Using the mean range of the survey results for an average, there are 7.6 uses per household per year and 2.5 logs are burned per use.

1999 Quantity of Wood Burned in Firepits = 20,351 active firepits × 7.6 uses/yr × 2.5 logs/use × 0.17 ft^3/log

= 65,734 ft^3/yr

1999 Mass of Wood Burned in Firepits = 65,734 ft3 × 31.57 lb/ft3

= 2,075,222 lbs/yr

= 1,037.61 tons/yr

Annual Emissions from Fireplaces, Woodstoves, and Firepits

The emission factors for residential fireplaces, woodstoves and firepits are included in Table 3-13.

Table 3-13. Emission Factors for Fireplaces, Woodstoves and Firepits

Pollutant	Residential Fireplaces & Firepits (lb/ton)	Woodstoves (lb/ton)
VOC	229.0	26.67
NO_x	2.6	4.68
CO	252.6	134.16

The residential fireplace emission factors are taken from an updated section of AP-42 (EPA, January 1995), Section 1.9, dated October of 1996. Since the amount of wood burned in fireplaces is estimated to be 20,965 tons annually the total tons of emissions from fire emissions were calculated as see in this example:

$$\text{Tons of CO from fireplaces} = \frac{16{,}261.38 \text{ tons of wood} \times 252.6 \text{ lb/ton}}{2{,}000 \text{ lb/ton}} = 2{,}053.81 \text{ tons}$$

The emission factor for conventional residential wood stoves was calculated as a weighted average. The weighted average emission factor was based on 80% as conventional, noncatalytic, catalytic, and masonry stoves and 20% as certified and exempt pellet stoves. The percentages were taken from the survey. The following calculation shows how the emission factors were calculated by weighted average using AP-42 emission factors for the various wood stove units (EPA, Oct. 1996).

Wood Stoves CO Emission Factor = 0.8 × [(230.8 + 140.8+ 104.4 + 149)/4] + 0.2 × [(39.4 + 52.2)/2]
Wood Stoves CO Emission Factor = 125 + 9.16 =134.16 lb/ton

$$\text{Tons of CO from conventional wood stoves} = \frac{540.43 \text{ tons} \times 134.16 \text{ lb/ton}}{2{,}000 \text{ lb/ton}} = 36.25 \text{ tons/yr}$$

For firepits, the emission factor used for fireplaces was used to estimate emissions. It was assumed these two devices generate similar emissions as they both lack controls.

$$\text{Tons of CO from firepits} = \frac{1{,}037.61 \text{ tons of wood} \times 252.6 \text{ lb/ton}}{2{,}000 \text{ lb/ton}} = 131.05 \text{ tons/yr}$$

Total emissions are included in Table 3-14.

Table 3-14. Annual and Season Day Emissions from Fireplaces, Woodstoves and Firepits

Type	VOC tons/yr	VOC tons/day	NO_x tons/yr	NO_x tons/day	CO tons/yr	CO Tons/day
Fireplaces	1861.93	–	21.14	–	2053.81	–
Woodstoves	7.21	–	1.26	–	36.25	–
Firepits	118.81	0.33	1.35	0.004	131.05	0.36
Totals:	1987.95	0.33	23.75	0.004	2221.11	0.36

Ozone Season Daily Emissions from Fireplaces, Wood Stoves, and Firepits

It is assumed that no woodburning in fireplaces and woodstoves occur during the ozone season. As mentioned earlier the use of fireplaces and wood stoves is primarily for aesthetic purposes. It is assumed that firepits are used evenly throughout the year, therefore annual emission totals are divided by 365. Results are shown in Table 3-14 above.

3.3.3.2 Residential Combustion Other

Other than wood, the only significant fuel for residential use in Maricopa County is natural gas. Natural gas sales for the residential category, 14,475.0 million cubic feet, are multiplied by the appropriate emission factor to determine emissions for the year.

The emission factors listed in AP-42, Table 1.4-1 for residential furnaces natural gas fuel combustion are only for NO_x and CO. For the VOC emission factor, MCESD is using 5.5 lb/MMCF as listed in Table 1.4-2 (EPA, 1998). Table 3-15 shows annual and average daily ozone season emissions for residential fuel external combustion.

Table 3-15. Annual and Season Day Emissions from Residential Natural Gas External Combustion

Pollutant	Emission Factor (lb/million cu ft)	Annual lbs/year	Annual tons/year	Season Day lbs/day	Season Day tons/day
VOC	5.5	79,613	39.81	96	0.05
NO_x	94.0	1,360,650	680.32	1,630	0.81
CO	40.0	579,000	289.50	694	0.35

The amount of natural gas used by residential external combustion area sources in June-August is 1,581.5 MMCF. The seasonal adjustment factor is determined as follows:

$$\text{Seasonal adjustment factor} = \frac{\text{June-August cubic feet}}{\text{Total cubic feet}} = \frac{1{,}581.5 \text{ MMCF}}{14{,}475.0 \text{ MMCF}} = 10.9\%$$

Table 5.8-1 of the procedures document (EPA, 1990) shows residential fuel combustion is equally distributed throughout the week. The average daily ozone season emissions are determined as follows:

$$\text{Average Daily Ozone Season CO Emissions} = \frac{\text{Annual Emissions (lb)} \times \text{Seasonal Factor}}{\text{Operation (days/week)} \times \text{Season (weeks/year)}}$$

$$= \frac{579{,}000 \times 0.109}{7 \times 13}$$

$$= 694 \text{ lbs/day}$$
$$= 0.35 \text{ tons/day}$$

3.3.3.3 Summary of All Residential Combustion

Table 3-16. Annual and Season Day Emissions from All Residential Combustion Sources

Category	VOC tons/yr	VOC tons/day	NO_x tons/yr	NO_x tons/day	CO tons/yr	CO tons/day
Fireplaces, woodstoves, and fire pits	1987.95	0.33	23.75	0.00	2221.11	0.36
Other	39.81	0.05	680.32	0.81	289.50	0.35
Totals:	**2027.76**	**0.38**	**704.07**	**0.81**	**2510.61**	**0.71**

3.3.4 Summary of Stationary Area Source Fuel Combustion

Table 3-17. Annual and Season Day Emissions from Stationary Area Combustion Sources

Category	VOC tons/yr	VOC tons/day	NO_x tons/yr	NO_x tons/day	CO tons/yr	CO tons/day
Industrial	151.25	0.48	2,109.96	6.69	603.31	1.90
Commercial/Institutional	213.57	0.59	4,801.69	13.11	1,089.46	2.92
Residential	2027.76	0.38	704.07	0.81	2510.61	0.71
Totals:	**2,392.58**	**1.45**	**7,615.72**	**20.61**	**4,203.38**	**5.53**

3.4 Industrial Processes

Most of the industrial process area source emissions listed in Table 3-19 were calculated based on the information in the Maricopa County annual emission reports submitted for 1999 (Appendix 2-1). Emissions from these area sources were calculated by using EPA emission factor documents AP-42, EPA's Factor Information and REtrieval data base (FIRE, version 6.23), engineering calculations, or facility-specific source test results. Individual business emissions were calculated by summing emissions from each process and then the businesses emissions of similar category were added together to obtain a category total. For example, a category such as printing inks manufacturing may have more than one process. The basic calculation used for all processes follows:

$$\text{Amount of VOC from Y} = (\text{Amount of Y used per year}) \times (\text{emission factor for Y})$$

Area source emissions that were not collected as part of the annual emissions reporting program were calculated using the annual emissions reports to calculate an emission factor based on lbs of VOC per employee. Data on employment for individual industrial categories was obtained from 1999 County Business Patterns (U.S. Census Bureau, 2000). The county's emissions reports are still categorized by Standard Industrial Classification (SIC) codes, while Census Bureau data is now presented using the North American Industrial Classification System (NAICS) codes. Thus SIC codes were converted using data from the U.S. Census Bureau website (U.S. Census Bureau, 1998). For categories that were assumed to contain sources that are not surveyed (or permitted), total emissions were calculated using a "scale-up" method: i.e., a county-specific per-employee emission factor was calculated from available emissions reports, and then multiplied by total county employment data from County Business Patterns. Season day emissions were usually calculated by dividing annual emissions by 260 (assuming a 5-day workweek, 52 weeks per year), or as explained in the following subsections.

3.4.1 Plastic Product and Rubber Manufacturing

Two categories were combined to estimate emissions. The 1999 emissions for this category were estimated using annual emission reports from area sources in Tier Code 0704, " Rubber & Miscellaneous Plastic Products". Area source emissions were based on the "scale-up" method using reported emissions (before rule effectiveness was applied) and employment data, as follows:

$$\text{VOC emissions per employee per year} = \frac{\text{(Total reported emissions from point + area sources)}}{\text{(Total reported employment from point + area sources)}}$$

$$= \frac{346.91 + 13.24 \text{ tons}}{4{,}232 + 2{,}748 \text{ employees}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= 103.2 \text{ lbs/employee-year}$$

Sources that submitted annual emissions inventories reported a total of 6,980 employees, while the 1999 County Business Patterns for NAICS codes 325991,3256, 3261, 3262 and 339113 reported total employment of 8,953. The additional 1,973 employees were thus presumed to be attributable to small (area) sources, which were not surveyed. The per-employee emission factor derived above was then added to the reported area-source emissions to derive total area source emissions for the category:

$$\text{Total area source emissions} = \text{total emissions reported from area sources} + \text{scale-up factor}$$
$$= 13.24 \text{ tons} + [(103.2 \text{ lbs/employee} \times 1{,}973 \text{ employees}) \times \text{tons}/2{,}000 \text{ lbs}]$$
$$= 115.05 \text{ tons/yr}$$

To calculate ozone season day emissions, data on operating schedules for those sources that reported emissions was used. The average summer-season percentage and days per week operating schedule were used, applying the following equation:

$$\text{Ozone season day VOC emissions} = \frac{\text{annual emissions} \times \text{(summer \%)}}{\text{days of operation/week} \times \text{weeks/season}}$$

$$= \frac{115.05 \text{ tons} \times 26.5\%}{5 \times 13}$$

$$= 938 \text{ lbs/day} = 0.47 \text{ tons/day}$$

3.4.2 Pharmaceutical Manufacturing

For this category the 1999 emissions were estimated using annual emission reports from area sources identified in SICs 2833 through 2836. It was assumed that there were no unpermitted sources in this category. Total annual VOC emissions were 45.65 tons/yr and ozone season day emissions were 356 lbs/day. Subtracting the emission totals from large point sources reported in Section 2 (42.14 tons/yr, or 324 lbs/day), the total area source emissions for this category is 3.50 tons/yr, with 31 lbs/day or 0.02 tons/day for the ozone season.

3.4.3 Agricultural, Food & Kindred Products.

This category includes all businesses in SIC Group 20. Bakeries (SIC 2051) comprise the largest sources within this category, and their emissions are accounted for in section 3.4.3.1. All other emissions were calculated as follows: using the county's emissions reporting database, twenty facilities were found that have VOC emissions not accounted for in the point source section. The total reported VOC emissions for food and kindred products are 17.36 tons/yr. These activities are assumed to occur six days a week, 52 weeks a year with no seasonal variation. Comparing reported facilities employees to the number of employees in the County Business Patterns, there was only a marginal difference, and therefore no more emissions were estimated according to emissions per employee. Total VOC from these sources in the nonattainment area is thus divided by 312 to determine daily VOC:

Daily VOC emissions = 17.36 tons/312 = 0.06 tons/day

3.4.3.1 Bakeries

The three largest bakeries in the nonattainment area were treated as point sources for determining VOC emissions, and their emissions are included in Section 2. These bakeries calculated VOC emissions by deriving the emission factors using the following equation, taken from the Alternative Control Technology Document for Bakery Oven Emissions, EPA Pub. 453/R-92-017.

$$\text{VOC Emission Factor lbs/ton} = 0.95(Yi) + 0.195(ti) - 0.51(S) - 0.86(ts) + 1.90$$

where: Yi = initial baker's percentage of yeast; S = final (spike) baker's percent of yeast
ti = total yeast action time (hours); ts = spike time (hours)

Using the maximum range of employees listed in the County Business Patterns of 1999, searching under SIC code 2051 in Maricopa County, there were 2,479 people employed in bakeries in 1999. Annual emission inventories completed by the bakeries reported a total of 712 employees, 240 of which are employees for bakeries accounted for in the point source section. The information from all the local bakeries in SIC code 2051 was scaled up to determine the per-employee emission factor to be used to calculate VOC emissions from the additional bakeries. The calculations below show how the per-employee emission factor was obtained.:

$$\text{Per-employee Emission Factor: Tons of VOC per employee} = \frac{\text{Total VOC from facilities}}{\text{(no. of employees)}}$$

$$= (102.27 \text{ tons}) / (712 \text{ employees})$$
$$= 0.14 \text{ tons VOC / employee}$$

$$\text{VOC from unreported area source bakeries} = \text{emission factor} \times \text{no. employees in unreported bakeries}$$
$$= 0.14 \text{ tons/employee} \times (2{,}479 - 712) \text{ employees}$$
$$= 0.14 \times 1{,}767$$
$$= 247.38 \text{ tons/yr}$$

Bakery activity is assumed to occur six days a week, 52 weeks a year with no significant seasonal variation. Total VOC from bakeries in the nonattainment area is thus divided by (6 × 52 =) 312 to determine daily VOC.

Daily VOC emissions = annual emissions / 312
= 247.38 tons / 312
= 0.79 tons/day

The annual VOC emissions from unreported bakeries were added to the reported area source bakery emissions, 48.80 tons/yr, for a total of 296.18 tons/yr. The ozone season daily emissions were totaled as well for a sum of 0.96 tons/day.

3.4.3.2 Summary of Agricultural, Food & Kindred Products

Total annual VOC emissions and daily VOC emissions are shown in Table 3-15a.

Table 3-18. Annual and Season Day VOC Emissions from Agricultural, Food and Kindred Products

Category	Annual VOC (tons/year)	Season Day VOC (tons/day)
Bakeries	296.18	0.96
Other	17.36	0.06
Total	313.54	1.02

3.4.4 Wood, Pulp & Paper, & Publishing Products

The 1999 emissions for this category were all considered as point sources, and are therefore included in Section 2. Since this type of source is not common in this region, and no area sources were reported, it was assumed that all significant sources are considered in the point source chapter.

3.4.5 Mineral Products

The 1999 emissions for this category were estimated using annual emission reports submitted from sources with Tier Code 0705 which covers brick and related clays as well as concrete products. The area source facilities reported total VOC emissions of 33.45 tons/yr. Daily area sources ozone season day emissions totaled 0.13 tons/day. It was assumed that there are no significant unpermitted sources in this category.

3.4.6 Electronic Equipment

For this category, emissions were estimated from facilities that reported under Tier Code 0707 in their annual reports. Those sources that submitted reports were not included in the point source section totaled 6.57 tons/yr VOC emissions. Ozone season day emissions were 0.03 tons/day. It was assumed that there are no significant unpermitted sources in this category.

3.4.7 Miscellaneous Industrial Processes

The 1999 emissions for this category were estimated using annual emission reports furnished by area sources with Tier Code 0710 that were not included in the above industrial categories. Area sources reported a total of 142.83 tons/yr VOC emissions. For ozone season day, 0.66 tons/day was estimated based on seasonal percentage and number of operating days reported.

3.4.8 Summary of Emissions from Industrial Processes

Table 3-19. Annual and Season Day VOC Emissions from Industrial Processes

Industrial Product Categories	Annual VOC (tons/yr)	Ozone Season Day VOC (tons/day)
Plastic Product Manufacturing	115.05	0.47
Pharmaceutical Manufacturing	3.50	0.02
Agriculture, Food & Kindred Products	313.54	1.02
Wood, Pulp & Paper, & Publishing Products	0	0
Mineral Products	33.45	0.13
Electronic Equipment	6.57	0.03
Miscellaneous Industrial Processes	142.83	0.66
Total	614.94	2.33

3.5 Solvent Utilization

3.5.1 Degreasing

3.5.1.1 Degreasing Cold Cleaning–Automotive Repair

Facilities in SIC group 75 submitted emissions information in their 1999 annual reports. The 1999 reported annual VOC emissions from cold cleaning in the automotive repair industry were 7.37 tons/yr. The ozone season day was calculated using reported season percentage and days per week of operation. Daily VOC emissions for this category were 0.02 tons/day.

3.5.1.2 Other Degreasing –Manufacturing

All other degreasing area sources are included in this section. This includes in-line, vapor and cold cleaning (other than automotive cold cleaning). All area source degreasing is added together except for automotive. Annual emission reports for 1999 provided 94.46 tons/yr as the total annual VOC emissions for area sources, and 0.35 tons/day as the total ozone season day VOC emissions.

This section covers SIC Groups 25 and 33 through 39. The 1999 emission reports, obtained from area sources, shows that there were an estimated 130 tons of VOC per year and 814 lbs per day (based on a six-day workweek). All emission reports are on file in Maricopa County. Table 3-20 provides the general information on degreasing processes provided on the 1999 emission reports submitted by the industries based on process tier codes.

Table 3-20. Degreasing Processes and Annual VOC Emissions

Tier Code	Tier Code Description	Annual VOC Emissions (tons)	% VOC Contribution
080101	Degreasing–Open Top	9.38	9.2
080102	Degreasing–Conveyorized	1.35	1.3
080103	Degreasing–Cold Cleaning	65.36	64.2
080199	Degreasing–General	25.74	25.3
Totals:		101.83	100

3.5.1.3 Summary of Degreasing

Table 3-21. Annual and Season Day VOC Emissions from Degreasing

Degreasing Type	Annual VOC (tons/year)	Average Daily Ozone Season VOC (tons/day)
Cold Cleaning–Auto Repair	7.37	0.02
All Other Degreasing	94.46	0.35
Totals:	101.83	0.37

3.5.2 Graphic Arts

In 1999, there were 326.58 tons of VOC reported from graphic art sources (SIC 27). Of this amount, 165.17 tons were emitted from point sources within the nonattainment area (Table 2-9). Of the facilities that reported, there are 5,209 employees. Using this information, the county created an emission factor:

Lbs VOC/employee = 653,135 lbs/ 5,209 employees = 125.39 lbs/employee

Using the 1999 County Business Patterns for employee data in this category, the total number of employees was 8,192. Subtracting this from the number of reported employees, 2,983 employees was multiplied by the above emission factor to calculate an additional 374,037 unreported pounds per year or 187.02 tons per year. Adding this to the reported amount of graphic arts emissions:

Annual VOC emissions from graphic arts = 161.41 tons/yr + 187.02 tons/yr
= 348.43 tons/yr

Those facilities that reported emissions also provided seasonal percentage of operations as well as days of the week. Therefore, ozone season day VOC emissions were 0.58 tons/day. An average of the reported area source facilities' seasonal percentage was 24.3%, operating 5 days a week, was used to estimate the ozone season day VOC emissions for the unreported area sources.

Daily unreported VOC = 374,040 lbs × (24.3/100) / (5 days × 13 weeks)
= 1,398 lbs/day
= 0.70 tons/day

Daily total VOC emissions = 0.58 tons/day + 0.70 tons/day
= 1.28 tons/day

3.5.3 Dry Cleaning

Area source dry cleaning facilities are divided into two types, those that use perchloroethylene and those that use petroleum solvent (140/Stoddard solvent). Perchloroethylene is a synthetic solvent that is not considered photochemically reactive and therefore is not included in this inventory, as stated in EPA's EIIP Vol. IV Chapter 4-Dry Cleaning (EPA, 1996). The 1999 VOC emissions were estimated using annual emission reports. (All permitted dry cleaners are surveyed annually.) Since approximately 98.5% of the Maricopa County population lives within the nonattainment area (Appendix 1-1), it is assumed that the dry cleaning VOC from Maricopa County is the same as total VOC emissions from the nonattainment area.

Dry cleaning activity is not constant throughout the year. The 1999 emission report contained seasonal percentages for each process as well as the number of operating days per week. These values were used to calculate ozone season day emissions from petroleum (Stoddard) solvent.

Annual VOC from petroleum solvent = 32.90 tons/yr

Ozone season day emissions = 0.13 tons/day

3.5.4 Surface Coating

Some of the sections below show examples of how emissions were calculated while other sections do not as the method is the same. All categories under surface coating, and their annual emissions and ozone season day emissions are given in Table 3-22. Emission report examples can be seen in Appendix 2-1. Per-capita emission factors were used only when employee and sources information was not available.

3.5.4.1 Large Appliances and Other Appliances

Total emissions reported in this category from annual emission reports totaled 14.82 tons/yr. Subtracting out those emissions accounted for from point sources (reported in Section 2), annual VOC emissions in this category was 1.65 tons/yr. Average daily ozone season VOC emissions from area sources were 16 lbs/day or 0.01 tons/day. When comparing employment provided by facilities that submitted an annual report to the 1999 County Business Patterns employment data for this category, it appears that all sources reported emissions.

3.5.4.2 Metal Coils, Sheets, and Strips

The 1999 emissions for this category were compiled with the annual emissions reports from facilities with Tier Codes 080405 through 080408. Of the 126.37 tons reported, 13.57 tons/yr were from area sources. For emissions from sources that have not reported, NAICS employment information from the 1999 County Business Patterns (U.S. Census Bureau, 2000), was used which lists employment by NAICS codes. For those categories with a range of employees, worst case scenario was used. When SIC codes were used in the area source guidance, the U.S. Census website was used to convert the SIC code to NAICS codes. There were 3,610 employees in all four NAICS groups minus the 1,665 employees that work in the facilities that reported emissions, which equaled 1,945 employees. These numbers were used with the scale-up method to determine area source VOC emissions in this category.

$$\text{Per-employee Emission Factor: Tons of VOC per employee} = \frac{\text{Total reported VOC}}{\text{(no. of employees)}}$$

$$= (126.37 \text{ tons}) / (1{,}665 \text{ employees})$$

$$= 0.076 \text{ tons VOC / employee}$$

$$\text{VOC from area sources} = \text{Emission factor} \times \text{no. employees in area sources}$$

$$= 0.076 \text{ tons/employee} \times 1{,}945 \text{ employees}$$

$$= 147.62 \text{ tons/yr}$$

The 13.57 tons/yr from reported area sources added to the 147.62 tons/yr estimated from unreported area sources, equaled 161.18 tons/yr. Emissions are assumed to occur five days a week and 52 weeks a year, thus:

Average Ozone Season Day VOC = (147.62 / 260) = 0.57 tons/day

This was added to the 0.05 tons/day VOC emissions from reported area source facilities for a total of 0.62 tons/day.

3.5.4.3 Paper/Fabric

The 1999 annual emissions reports showed that area sources emitted a total of 35.64 tons of VOC not including those sources accounted for in the point source section. This was based on facilities with Tier Codes 080402 and 080403. Ozone season day emissions for the area sources in this category totaled 0.14 tons/day.

3.5.4.4 Wood Furniture

In 1999, emissions reports submitted to Maricopa County ESD reported total VOC emissions of 1,116.24 tons for facilities with Tier code 080409 in Maricopa County. Point source emissions inventories for businesses with this Tier code reported total emissions of 1,373.20 tons VOC, while area sources totaled 140.44 tons VOC emissions. Seasonal percentages and weekly days of operation were used to calculate the reported VOC season day emissions of 0.56 tons/day. When comparing employment data provided by facilities that submitted annual reports with 1999 County Business Patterns employment data for this category, it appears that there are no significant unpermitted sources in this category.

3.5.4.5 Factory Finished Wood

For 1999, area source VOC emissions totaled 26.68 tons, as estimated from annual emission reports. Factory finished wood sources are reported under Tier code 080411. Those facilities reported as point sources were subtracted from the total annual emissions to determine the area source emissions. Using reported operating schedule data, total ozone season day VOC emissions from this category totaled 0.10 tons/day.

3.5.4.6 Miscellaneous Finished Metals

The 1999 emissions were estimated using annual emission reports from sources with Tier Codes 080415 and 080416. There were 156.40 tons/yr emitted by area sources; ozone season day VOC emissions totaled 0.60 tons/day.

3.5.4.7 Plastic Products

Annual emission reports were used to estimate emissions for this category. Area sources reported 35.31 tons/yr and 0.15 tons/day for ozone season day. Tier code 080412 was used to identify sources that constitute this category.

3.5.4.8 Marine

Emissions for 1999 were estimated using the scale-up method shown below based on 150 tons reported by three sources with 370 employees. Only 0.77 tons of the 150 tons are not reported in the point source section. The County Business Patterns for Maricopa County showed an additional 218 employees in area sources in SIC Group 373.

Marine per-employee VOC Emission Factor = VOC from Point Sources / Employees at Point Sources
= 150 tons / 370 employees
= 0.41 tons/employee = 811 lbs/employee

Unreported VOC Emissions = (0.41 tons/employee × 218 employees) = 89.38 tons

Therefore, 89.38 tons plus the 0.77 reported tons not accounted for in the point source section, totals 90.15 tons of VOC.

999 Average Season Day Emissions = 90.15 tons / 260 days = 0.35 tons/day

3.5.4.9 Railroad Coatings

There were 249 employees from sources in SIC code 3743, based on the 1999 County Business Patterns. An annual emission factor of 35 lbs/employee (EPA, 1991b) was used to estimate emissions. Season day emissions were calculated by dividing annual emissions by 260 days.

Annual VOC emissions = employees × 35 lbs/employee·yr
= 249 employees × 35 lbs/employee·yr
= 8,715 lbs/yr = 4.36 tons/yr

Season day VOC emissions = 4.36 / 260 = 0.02 tons/day

3.5.4.10 Machinery and Equipment

VOC emissions from the annual emissions report totaled 15.98 tons/yr for area sources. From those facilities that reported, there were 1,200 employees. The emission factor for machinery and equipment is 77 pounds of VOC per employee per year (EPA, 1991b). For SIC codes beginning with 35 (minus those accounted for in Sections 3.5.4.1, 3.5.4.2, and 3.5.4.6), the 1999 County Business Patterns estimated 2,501 employees. Employees from sources with reported emissions were subtracted out for a total of 1,301 employees. For the season daily emissions, it is assumed these operations typically run 260 days/year without seasonal variation.

Annual VOC emissions = 1301 employees × 77 lbs/employee
= 100,177 lbs
= 50.09 tons/yr

Season day VOC emissions = 50.09 / 260 = 0.19 tons/day or 385 lbs/day

This was added to the VOC emissions reported from area sources of 0.06 tons/day, for a total 0.25 tons/day. The 50.09 tons/yr was added to the reported 15.98 tons/yr for a total of 66.07 tons/yr.

3.5.4.11 High-Performance Maintenance Coatings

The reported annual VOC emissions from high-performance maintenance coatings were 30.65 tons/yr. This data was accumulated from facilities with Tier code 080414. For the season daily emissions, this category's sources emitted 0.11 tons/day. It was assumed that there are no significant unpermitted emission sources in this category.

3.5.4.12 Other Special Purpose Coatings

The annual emission reports were used to estimate VOC emissions from this category, and Tier Code 080423 was used. 19.60 tons/yr of annual VOC emissions were reported from area sources, as well as 0.07 tons of VOC for ozone season day. It was assumed that there are no significant unpermitted emission sources in this category.

3.5.4.13 Metal Furniture

Emissions for 1999 were estimated based on annual emissions reports. Area sources with Tier Code 080410 reported annual VOC emissions of 1.50 tons/yr, as well as 14 lbs/day or 0.01 tons/day for ozone season day. When comparing employment data from those facilities that reported to the 1999 County Business Patterns

employment data, it appeared that all sources had reported their emissions, therefore further emissions were not estimated.

3.5.4.14 Other Surface Coating

This category covers all other sources that were not accounted for in the above sections, Tier codes 080401, 080419, 080424-080426 and 080499. From the annual emission reports, area source facilities reported 177.42 total tons/yr VOC emissions. Ozone season day emissions totaled 0.61 tons/day.

3.5.4.15 Summary of Industrial Surface Coating

Surface coating emissions were estimated by using employee based emission factors with business pattern employment data, emission reports, or per capita emission factors. In all sections without reported emissions, annual area source VOC is divided by the number of activity days per week, assumed to be 260 days per year, to obtain daily VOC. Table 3-22 provides a summary of surface coating emissions. The per capita emission factors and those per employee emissions factors that were not manufactured from county values, came from Table 4-10-1 in the Procedures document (EPA, 1991b).

Table 3-22. Annual and Season Day VOC Emissions from Industrial Surface Coating

Category	Annual VOC Emissions (tons/yr)	Season Day VOC Emissions (tons/day)
Large Appliances and Other Appliances	1.65	0.01
Metal Coils, Sheets, and Strips	161.18	0.62
Paper/Fabric	35.64	0.14
Wood Furniture	140.44	0.56
Factory Finished Wood	26.68	0.10
Miscellaneous Finished Metals	156.40	0.60
Plastic Products	35.31	0.15
Marine	90.15	0.35
Railroad Coatings	4.36	0.02
Machinery and Equipment	66.07	0.25
High-Performance Coatings	30.65	0.11
Other Special Purpose Coatings	19.60	0.07
Metal Furniture	1.50	0.01
Other Surface Coating	177.42	0.61
Totals:	947.05	3.60

3.5.5 Non-industrial Surface Coating

The default emission factors in Table 4.3-6 of the procedures document (EPA, 1991b) are used to calculate architectural coating, automotive refinishing and traffic markings VOC emissions in the Maricopa County nonattainment area. SIC code employment data was applied where available.

3.5.5.1 Architectural Coatings

The EPA architectural coatings VOC per capita emission factor is used to calculate annual 1999 architectural VOC emissions within the Maricopa County nonattainment area. This emission factor of 4.6 lbs VOC/ capita per year (EPA, 1991b) is multiplied by the 1999 nonattainment area population 2,957,147 (see Section 1.0) to obtain the annual VOC emissions from architectural coat in the nonattainment area.

Activity level is given to be seven days a week with an ozone season adjustment factor of 1.3 (EPA, May, 1991). However, in Maricopa County, architectural coatings usage is not reduced in the winter months, as is the case with other counties nationwide. In fact, any reduction in architectural coatings usage would most likely occur during the ozone season. Thus no ozone season adjustment factor has been used. Calculations are provided below.

Architectural coatings annual VOC = Population × emission factor
= 2,957,147 × 4.6 lbs/capita-yr
= 13,602,876 lbs/yr
= 6,801.44 tons/yr

An estimate of the average daily ozone season architectural coating VOC emissions is calculated by dividing the annual VOC emissions by 365:

Architectural coatings daily VOC = 6,801.44 tons/year / 365 = 18.63 tons/day

3.5.5.2 Automobile Refinishing

For 1999, annual VOC emissions from area sources in this category totaled 264.36 tons/yr. This total was reported from facilities' annual emission reports for Tier Code 080421. Ozone season day emissions were 1.02 tons/day. Total employment reported by point and area sources facilities was comparable to employment data obtained from the County Business Patterns website. Thus it was assumed that there are no significant unpermitted sources in this category.

3.5.5.3 Traffic Markings

The per employee emission factor for coatings used as traffic markings is 69 pounds per employee (EPA, 1991b).

Traffic markings annual VOC = employees × emission factor
= 3,984 employees × 69 lbs/employee
= 274,896 lbs/yr
= 137.45 tons/yr

Traffic marking activity is assumed 6 days/week, 52 weeks/year with no seasonal variation. Thus the VOC estimate for the average daily ozone season is calculated by dividing the annual VOC emissions by 312.

Traffic markings daily VOC = 274,896 lbs / 312
= 881 lbs/day
= 0.44 tons/day

3.5.5.4 Summary of Non-industrial Solvent Utilization

Table 3-23. Annual and Season Day Emissions from Non-industrial Solvent Utilization

Category	Annual VOC Emissions (tons/yr)	Season Day VOC Emissions (tons/day)
Architectural Coatings	6,801.44	18.63
Automobile Refinishing	264.36	1.02
Traffic Markings	137.45	0.44
Totals:	7,203.25	20.09

3.5.6 Other Solvent Utilization

3.5.6.1 Asphalt Paving

Asphalt use data for 1999 were obtained from the Asphalt Institute. Since the total amount of asphalt used within the state of Arizona is the only information available, the amount used in the nonattainment area was estimated by multiplying the amount of asphalt statewide by the nonattainment area factor (calculated below).

Nonattainment area factor = (Urban Nonattainment VMT) / (State VMT)
= 60,246,000 / 130,377,000
= 0.462

The VMT figures were obtained from HPMS data prepared by Arizona Department of Transportation (ADOT, 2001). It is assumed that the amount of cutback, emulsified, and roofing asphalt is equally used throughout the year and five days a week; thus annual emissions are divided by 260 to obtain ozone season daily emissions.

Cutback Asphalt

In 1999 there were 13,330 tons of cutback asphalt used in the State of Arizona. All of this cutback asphalt was Medium Cure with an assumed diluent density of 0.8 kg/liter (EPA, 1995). The actual diluent contents are not known so a value of 35 percent is assumed for inventory purposes (MCESD, 1993). Based on those assumptions, an emission factor of 0.20 lbs of VOC per pound of cutback asphalt is used (EPA, 1995).

Annual Tons of VOC from cutback asphalt in state = (tons of asphalt) × (emission factor)
= 13,330 × 0.20
= 2,666 tons/yr

Annual tons of VOC from cutback asphalt in the nonattainment area = (state VOC) × (area factor)
= 2,666 × 0.462
= 1,231.69 tons/yr

Average Daily Ozone Season VOC emissions from cutback asphalt = (annual VOC) / (260)
= 1231.69 tons / 260 days
= 4.74 tons/day

Emulsified Asphalt

In 1999 there were 46,505 tons of emulsified asphalt used for paving in the state of Arizona. There are 8.33 lbs of asphalt per gallon of emulsified asphalt (MAG, 1979). The emission factor for emulsified asphalt is 0.22 lbs of VOC per gallon (EPA, 1991b).

Pounds of emulsified asphalt = (tons asphalt) × (2000 lbs/ton)
= 46,505 × 2000
= 9.30×10^7 lbs

Gallons of emulsified asphalt = (lbs of asphalt) / (lbs per gal)
= 9.30×10^7 / 8.33
= 1.12×10^7 gal

Lbs of VOC from emulsified asphalt statewide = (Gallons of asphalt) × (emission factor)
= $1.12 \times 10^7 \times 0.22$
= 2,456,447 lbs/yr

Lbs of VOC in nonattainment area = (state VOC) × (area nonattainment VMT ratio)
= 2,456,447 × 0.465
= 1,142,248 lbs

Tons of VOC in nonattainment area = (lbs of VOC) / (2000)
= 1,142,248 lbs / 2000
= 571.12 tons

Average Daily Ozone Season VOC emissions = (annual VOC) / (260)
= 571.12 tons / 260 days
= 2.20 tons/day

Roofing Asphalt

In 1999, 8,287 tons of roofing asphalt was used in the State of Arizona. An emission factor of 20 lbs of VOC per ton of asphalt was used (SCAQMD, 1996). Arizona's population estimate in 1999 was 4,462,300 (DES, 1999). The population of the nonattainment area in 1999 was 2,957,147 (see Section 1.1, Table 1-3). The amount of roofing asphalt used in the nonattainment area is calculated as follows.

Nonattainment % = percent of total Arizona population within the nonattainment area
= 2,957,147 / 4,462,300
= 0.663

Roofing asphalt used in nonattainment area = (Total asphalt used) × (nonattainment %)
= 8,287 tons × 0.663
= 5,492 tons

1999 VOC in nonattainment area from roofing asphalt = (tons asphalt) × (emission factor)
= 5,492 tons × 20 lbs/ton
= 109,835 lbs/yr
= 54.92 tons/yr

Average Daily Ozone Season VOC emissions = (annual VOC) / (260 days)
= 54.92 / 260
= 0.21 tons/day

Summary of Asphalt Paving

Table 3-24 shows annual and average daily ozone season VOC emissions for cutback, emulsified, and roofing asphalt.

Table 3-24. Annual and Season Day VOC Emissions from Asphalt Use

Asphalt Type	Annual VOC (tons/year)	Average Daily Ozone Season VOC (tons/day)
Cutback Asphalt	1,231.69	4.74
Emulsified Asphalt	571.12	2.20
Roofing Asphalt	54.92	0.21
Totals:	1,857.73	7.15

3.5.6.2 Commercial/Consumer Solvent Use

The EPA commercial/consumer solvent use VOC emission factors are used to calculate the 1999 VOC emissions within the Maricopa County nonattainment area. The emission factors (EPA, 1996) were multiplied by

the 1999 nonattainment area population 2,957,147 (see Section 1.0) to obtain annual commercial/consumer solvent use VOC emissions. While EPA guidance provides a total per-capita emission factor for this category of 7.84 lbs/year, FIFRA-regulated products were calculated separately under structural pesticide application.

The activity level for commercial/consumer solvent use is uniform throughout the year (EPA, 1996) and that this activity is seven days a week. An estimate of the average daily ozone season commercial/consumer solvent use is calculated by dividing the annual VOC emissions by 365.

Household Products:

Annual VOC = Population × emission factor
= 2,957,147 × 0.79 lbs/person·yr
= 2,336,146 lbs/yr
= 1,168.1 tons/yr
Daily VOC = 1,168.1 / 365 = 3.20 tons/day

Personal Care Products:

Annual VOC = Population × emission factor
= 2,957,147 × 2.32 lbs/person·yr
= 6,860,581 lbs/yr
= 3,430.3 tons/yr
Daily VOC = 3,430.3 / 365 = 9.40 tons/day

Adhesives and Sealants*:*

Annual VOC = Population × emission factor
= 2,957,147 × 0.57 lbs/person·yr
= 1,685,574 lbs/yr
= 842.79 tons/yr
Daily VOC = 842.79 / 365 = 2.31 tons/day

Automotive Aftermarket Products:

Annual VOC = Population × emission factor
= 2,957,147 × 1.36 lbs/person·yr
= 4,021,720 lbs/yr
= 2,010.86 tons/yr
Daily VOC = 2,010.86 / 365 = 5.51 tons/day

Coatings and Related Products:

Annual VOC = Population × emission factor
= 2,957,147 × 0.95 lbs/person·yr
= 2,809,290 lbs/yr
= 1404.64 tons/yr
Daily VOC = 1404.64 / 365 = 3.85 tons/day

Miscellaneous Products:

Annual VOC = Population × emission factor
= 2,957,147 × 0.07 lbs/person·yr
= 207,000 lbs/yr
= 103.50 tons/yr
Daily VOC = 103.50 / 365 = 0.28 tons/day

Annual Total Commercial/Consumer Solvent Use:

Annual VOC = Population × emission factor
= 2,957,147 × 6.06 lbs/person·yr
= 17,920,311 lbs/yr
= 8,960.16 tons/yr
Daily VOC = 8,960.16 / 365 = 24.55 tons/day

3.5.6.3 Pesticide Application

Pesticides include any substances used to kill or retard the growth of insects, rodents, plants, fungi, or microorganisms. The pesticide category includes both organic pesticides and herbicides. Inorganic pesticides are excluded from this inventory because they do not contain VOC. Pesticide use is divided into two categories: (1) Structural/Municipal and (2) Agricultural.

Structural/Municipal

Structural/municipal pesticide use is seen as pesticides used in structures as well as those used outside (i.e. for vector control). Since survey data was not available as suggested to use in Chapter 9 Pesticides (EPA, June 2001), the next alternative method that was suggested was employed. The pound per capita emission factor for FIFRA-regulated products was used from EIIP, Chapter 5, Consumer and Commercial Solvent Use (EPA, 1996). FIFRA-regulated products included house and garden pesticides, as well as commercially used pesticides. Emissions were calculated as shown below.

Annual VOC = Population × emission factor
= 2,957,147 × 1.78 lbs/person·yr
= 5,263,722 lbs/yr
= 2,631.86 tons/yr
Daily VOC = 2,631.86 / 365 = 7.21 tons/day

Agricultural

The Arizona Department of Agriculture supplied MCESD with the data on pesticide usage for 1999. The data included active ingredient, date and number of acres applied, whether it was ground or air applied, and the amount of active ingredients applied. Chapter 9 on pesticides from the EIIP Volume III was used as a source of emission factors and equations (EPA, June 2001). The preferred method for calculating emissions from non-aerial application of pesticides is to use the following equation:

Annual agricultural pesticide VOC emissions = R × A × PA × EF

where:

R = pounds of pesticide applied per year per harvested acre
A = total harvested acres
PA = fraction active ingredient in the pesticide applied
EF = emission factor from Table 9.4-4 of EIIP based on vapor pressure of active ingredient.

R and A factors were reported combined. Since the Department reported by active ingredients, PA was considered 100%. Vapor pressure of the active ingredient was not provided, however many of the pesticides on the Department's list had their vapor pressures listed in the EIIP Chapter 9 Table 9.4-2. Emission factors for these pesticides were then chosen from Table 9.4-4. Since the Department did not specify whether ground application meant surface application or soil incorporation, the County used the more conservative emission factors for surface application. Those sources without vapor pressure values available were given the default emission factor provided in Chapter 9 of 2.45 lbs VOC/lb active ingredient. Totaling these calculated emissions, annual VOC emissions from

pesticide usage in 1999 was 414.40 tons. Since the date the pesticides were applied was given, VOC emissions for ozone season day was calculated using the total pesticides applied in June through August and assuming 6 days of application a week for 13 weeks.

Ozone Season Day for agricultural pesticide VOC emissions = 20.16 tons/(6 days/week × 13 weeks)
= 0.26 tons/day

The above method for estimating annual VOC emissions can not be used for aerial applications of pesticides. A total of 3.42 million pounds of aerial applied pesticides was reported for which no VOC content or other emission factor data could be found. The vast majority (97.5%) of these were biopesticides, either bacillus cereus (2.63 million lbs. reported) or Bt (*bacillus thur.*, 0.71 million lbs.). It was assumed that these biopesticides have negligible ozone precursor emissions.

Total

Therefore, the total amount of VOC emissions estimated for pesticide application was 3,046.26 tons/yr. Total ozone season day VOC emissions were 7.47 tons/day.

3.5.6.4 Other

Emissions in this category are estimated based on 1999 emission reports. A review of all 1999 emission reports was conducted, and sources already accounted for were subtracted out (e.g., all point sources, incinerators, sources accounted for in degreasing, dry cleaners, and gas storage). Other potential sources of solvent use include city service centers and maintenance yards, schools, electronics manufacturing, laboratories, and other business services. Annual emissions from this category total 65.3 tons. A multiplier of 50% was then applied to account for sources that were either unpermitted or not surveyed. The revised annual emissions total is 97.95 tons/year.

Assuming a 5-day workweek with no significant seasonal variation, average daily ozone season emissions are calculated as follows:

Average daily ozone season VOC emissions = 97.95 tons / 260 days = 0.38 tons/day

3.5.6.5 Summary of Other Solvent Use

Table 3-25. Annual and Season Day VOC Emissions from Other Solvent Use

Category	Annual VOC (tons/year)	Average Daily Ozone Season VOC (tons/day)
Asphalt	1,857.73	7.15
Consumer/Commercial Solvent Use	8,960.16	24.55
Pesticide Application	3,046.26	7.47
Other	97.95	0.38
Total Other Solvent Use Emissions:	**13,962.10**	**39.55**

3.5.7 Summary of Solvent Utilization

Table 3-26. Annual and Season Day VOC Emissions from Solvent Utilization

Category	Annual VOC (tons/year)	Average Daily Ozone Season VOC (tons/day)
Degreasing	101.83	0.37
Graphic Arts	348.43	1.28
Dry Cleaning	32.90	0.13
Surface Coating	947.05	3.60
Non-industrial	7203.25	20.09
Other Solvent Use	13,962.10	39.55
Total	**22,595.56**	**65.02**

3.6 Storage and Transport

AP-42 and TANKS3 were used to estimate petroleum products and volatile organic liquid above ground storage and loading emissions. An average 1999 day in Maricopa County is 74°F, with a wind speed of 6.1 mph, and an atmospheric pressure of 14.1 psia. The average ozone season day temperature is 91°F. Specific equations when TANKS3 was not used are illustrated within a section.

Equations used for estimating emissions of the category Storage, Transportation, and Marketing of Petroleum Products and Volatile Organic Liquids are adjusted for temperature and vapor pressure. In Maricopa County, State law mandates gasoline with an RVP below 9.0 for the winter and an RVP below 7.0 for the summer. For the annual emissions, RVP below 9.0 was used. An ambient temperature of 75°F was used for the annual calculation for a true vapor pressure of 6.0 psia for RVP 9.0 and an ozone season temperature of 96°F was used for the season daily calculation for a true vapor pressure of 6.8 psia for RVP 7.0.

3.6.1 Petroleum & Petroleum Product Transport

3.6.1.1 Tank Truck Cleaning

Tank truck pressure testing was substituted for tank truck cleaning. The purging of vapors is one step in the annual pressure testing certification procedure required in Maricopa County under Rule 352. Vapor purging emissions are used to determine tank truck cleaning VOC emissions.

From the phone-in notification log required prior to conducting a test, 688 tank truck pressure tests were performed in 1999. Additional purges for other reasons (repairs, etc.) are assumed to be 8 percent of the number of pressure tests; thus a total of $(688 \times 1.08 = 743)$ purges has been used. The average size tank is 9,000 gallons (Buonicore et al., 1991). The total number of gallons of vapors purged by area sources is therefore:

$$743 \text{ purges} \times 9{,}000 \text{ gallons each} = 6{,}687{,}000 \text{ gallons}$$

The mass of VOC vapors purged from drained gasoline tank trucks is assumed comparable to the vapors expelled by loading gasoline into such trucks, as shown in the example in AP-42. The AP-42 equation for estimating loading loss VOC emissions without vapor controls is:

$$EF = \frac{12.46 \times S \times P \times M}{T}$$

where: EF = emission factor in pounds of VOC per 1,000 gallons
S = saturation factor (1.0)
P = true vapor pressure, psia (6.0 yearly average, 75°F; 6.8 ozone season, 96°F)
M = molecular weight in lb/lb·mol of RVP9 during winter season and RVP7 during summer season (68 in ozone season)
T = temperature of liquid loaded in °R (°R = °F + 460)
for annual average, 75°F = 535°R
for ozone season, 96°F = 556°R

$$EF\ (annual) = \left(\frac{12.46 \times 1.0 \times 6.0 \times 68}{535}\right) = 9.5\ lb/1000\ gallons$$

$$EF\ (ozone\ season) = \left(\frac{12.46 \times 1.0 \times 6.8 \times 68}{556}\right) = 10.4\ lb/1000\ gallons$$

Annual VOC emissions from
area source tank truck purging = (9.5 lbs/1000 gals) × (6,687,000 gals)
= 63,526 lbs/yr
= 31.76 tons/yr

Peak ozone season daily emissions are calculated using the same equations with ozone season values for P and T as noted above. The log showed that 246 purges occurred during July, August, and September. As the 55 purges estimated for annual repairs were distributed evenly throughout the year, it is assumed that 14 occurred during the ozone season. Daily ozone season VOC emissions from area sources are calculated below.

$$\text{Gallons of vapor purged per season day} = \frac{(246 + 14)\ \text{purges} \times 9000\ \text{gal/purge}}{5\ \text{days/week} \times 13\ \text{weeks/yr}} = 36{,}000\ \text{gal/day}$$

Area source daily ozone season VOC = Emission factor × gallons per day
= 10.4 lb/1000 gal × 36,000 gal/day
= 374.4 lb/day or 0.19 tons/day

3.6.1.2 Tank Truck Unloading

Gasoline Usage in the Nonattainment Area:

Gasoline sales tax data for all of Maricopa County are used to estimate total gallons of gasoline used in the nonattainment area. The procedures document states that sales tax data must be altered to account for the gasoline usage by facilities that are not taxed and to show gasoline usage only in the nonattainment area of the total county. Unadjusted total county sales tax data are used to calculate emissions since there is an approximate 1.2% increase because of omitted non-taxed gasoline and an approximate decrease of 1.5% because of the amount of the gasoline used outside the nonattainment area. A more detailed explanation of why these alterations were not made follows.

The amount of gasoline used by non-taxed facilities in the nonattainment area in 1993 was only 11.9×10^6 gallons. Tax data shows there were an estimated 1.55×10^9 gallons of gasoline used in Maricopa County in 1999 which includes non-taxed sales. Taxed and non-taxed sales are not separated for 1999. From 1993 data, non-taxed gasoline usage is about 1.2 % of the total amount used.

Taking the ratio of the population in the nonattainment area to the population outside the nonattainment area (but within the county) and applying this ratio to the Maricopa County gasoline sales tax data can approximate the amount of gasoline used only in the nonattainment area. For example, roughly 1.5% of the population of

Maricopa County lives outside the nonattainment area (Appendix 1-1), so it can be assumed that approximately 1.5% of the Maricopa County gasoline, or 2.31×10^{7} gallons, is burned outside the nonattainment area. This method seems reasonable but does not take into consideration those living outside the nonattainment area that drive to work inside the nonattainment area.

After applying these methods to revise County gasoline sales tax data and taking into consideration the availability of ozone season gasoline sales tax data, it was agreed that the total county sales tax data would be used to represent the amount of gasoline used in the nonattainment area. It is our judgment that this approach is accurate and provides quality seasonal data. It is concluded that 1.55×10^{9} gallons of gasoline were used in the nonattainment area in 1999. Diesel fuel is not included in total fuel used, as suggested on page 4-6 of the procedures document (EPA, 1991b).

During the 1999 ozone season (July–September) the estimated total gallons of gasoline used is 3.66×10^{8} gallons (ADOT, 1999). The 1999 ozone season gasoline fuel use was 23.7 percent of the total 1999 annual gasoline fuel use. Based on Maricopa County 1990 emission reports, 98% percent of the gasoline was from tank truck unloading using balance fill, less than 2% was from submerged fill, and there was no splash filling.

Control effectiveness of 90% is required for tank truck unloading in accordance with Maricopa County Rule 353. A study on the effectiveness of this rule done in 1999 found that the overall effectiveness was 40% (MCESD, May 2000). Applying a rule effectiveness of 80%, the total controlled tank truck unloading VOC emissions were calculated assuming a 50% control efficiency for a total control effectiveness of 60% (1-(0.8 × 0.5)) = 0.60) (EPA, Sept. 1999).

Methodology:

Annual Gasoline Unloaded:

98% balance fill = (Total 1999 gas) × (% balance fill)
= $(1.55\times10^{9}$ gal) × 0.98
= 1.519×10^{9} gal/yr

2% submerged fill = (Total 1999 gas) × (% submerged fill)
= $(1.16\times10^{9}$ gal) × 0.02
= 2.320×10^{7} gal/yr

Ozone Season Gasoline Unloaded:

98% balance fill = (Ozone season gas) × (% balance fill)
= $(2.74\times10^{8}$ gal) × 0.98
= 2.685×10^{8} gal/ozone season

2% submerged fill = (Ozone season gas) × (% submerged fill)
= $(2.74\times10^{8}$ gal) × 0.02
= 5.480×10^{6} gal/ozone season

The ozone season and annual emissions take into consideration the type of loading as well as temperature of gasoline, true vapor pressure, molecular weight, and control efficiency (EPA, 1995). This is more accurate than the VOC emission factors provided both in AP-42 and EIIP Chapter 11, Gasoline Marketing. The formula used to calculate the emission factor used to determine the annual VOC emissions from controlled balance fill gasoline tank truck unloading is (EPA, 1995):

$$EF = \frac{(12.46 \times S \times P \times M)}{T} \times \text{60\% efficiency factor}$$

$$= \frac{(12.46 \times 1.0 \times 4.7 \times 68)}{534} \times 0.60$$

$$= 7.46 \times 0.60$$

$$= 4.48 \text{ lb/1000 gal}$$

where: EF = emission factor in pounds VOC per 1000 gallons fuel throughput
S = saturation factor (1.0)
P = fuel true vapor pressure in psia (4.7)
M = fuel molecular weight in lb/lb·mol (68)
T = temperature of liquid loaded in R° (460 + 74°F = 534°R)

The formula used to calculate the emission factor used to determine the annual submerged fill VOC emissions from gasoline tank truck unloading is shown below (EPA, 1995).

$$EF = \frac{(12.46 \times S \times P \times M)}{T}$$

$$= \frac{(12.46 \times 0.6 \times 4.7 \times 68)}{534}$$

$$= 4.48 \text{ lb/1000 gal}$$

where: EF = emission factor in pounds VOC per 1000 gallons fuel throughput
S = saturation factor (0.6)
P = fuel true vapor pressure in psia (4.7)
M = fuel molecular weight in lb/lb·mol (68)
T = temperature of liquid loaded in R (460 + 74°F = 534 R)

The formula used to calculate the emission factor used to determine the VOC emissions from gasoline tank truck unloading using controlled balance fill during the ozone season is shown below (EPA, 1995).

$$EF = \frac{(12.46 \times S \times P \times M)}{T} \times 60\% \text{ efficiency factor}$$

$$= \frac{(12.46 \times 1.0 \times 6.3 \times 68)}{551} \times 0.60$$

$$= 9.69 \times 0.60$$

$$= 5.81 \text{ lb/1000 gal}$$

where: EF = emission factor in pounds VOC per 1000 gallons fuel throughput
S = saturation factor (1.0)
P = fuel true vapor pressure in psia (6.3)
M = fuel molecular weight in lb/lb·mol (68)
T = temperature of liquid loaded in R (460 + 91°F = 551 R)

The formula used to calculate the emission factor used to determine the submerged fill ozone season VOC emissions from gasoline tank truck unloading is shown below (EPA, 1995).

$$EF = \frac{(12.46 \times S \times P \times M)}{T}$$

$$= \frac{(12.46 \times 0.6 \times 6.3 \times 68)}{551}$$

= 5.81 lb/1000 gal

where: EF = emission factor in pounds VOC per 1000 gallons fuel throughput
S = saturation factor (0.6)
P = fuel true vapor pressure in psia (6.8)
M = fuel molecular weight in lb/lb·mol (68)
T = temperature of liquid loaded in R (460 + F°)

The emission factors calculated above are multiplied by throughput to determine controlled VOC. Tank truck unloading is conducted 6 days a week and 13 weeks a season (EPA, 1991b). The amount VOC generated during the 1999 ozone season is divided by 78 days (6 days/week × 13 weeks) to obtain the daily ozone season VOC.

Summary of Tank Truck Unloading:

VOC (balance fill) = gallons from balance fill × emission factor
VOC (submerged fill) = gallons from submerged fill × emission factor

Annual VOC from controlled balance fill tank truck unloading = $(1.519 \times 10^9$ gal) × (4.48 lb/1000 gal)
= 6,805,120 lbs/yr
= 3,402.56 tons/yr

Annual VOC from submerged fill tank truck unloading = $(2.32 \times 10^7$ gal) × (4.48 lb/1000 gal)
= 103,936 lbs/yr
= 51.97 tons/yr

Total annual VOC emissions from tank truck unloading = 3,402.56 + 51.97 = 3,454.53 tons/yr

Ozone season day VOC, controlled balance fill tank truck unloading = $\frac{(2.685 \times 10^8 \text{ gal}) \times (5.81 \text{ lb}/1000 \text{ gal})}{78 \text{ days}}$
= 20,000 lbs/day
= 10.00 tons/day

Ozone season day VOC, submerged fill tank truck unloading = $\frac{(5.480 \times 10^6 \text{ gal}) \times (5.81 \text{ lb}/1000 \text{ gal})}{78 \text{ days}}$
= 408 lbs/day
= 0.20 tons/day

Total season day VOC emissions from tank truck unloading = 10.00 + 0.20 = 10.20 tons/day

3.6.1.3 Tank Trucks in Transit

The VOC emission factor for gasoline vapor loss during tank truck transit is 0.06 lb/1000 gal. This is a round-trip emission factor calculated by adding the tank truck transit loaded with fuel emission factor of 0.005 lb/1000 gallons to the return with vapor emission factor 0.055 lb/1000 gallons (EPA, Jan. 2001).

Total gasoline transported is calculated by multiplying gasoline distribution in the nonattainment area by the default factor of 1.25 (EPA, 1991b).

Transported gasoline = $(1.93 \times 10^9$ gallons$) \times 1.25$
= 2.41×10^9 gal/yr

Emissions from round-trip tank truck transit is calculated as follows:

Total VOC from tank truck transit = Gasoline transported × emission factor
= $(2.41 \times 10^9$ gal$) \times$ (0.06 lb/1000 gal)
= 144,750 lbs/yr
= 72.38 tons/yr

Assuming that tank truck transit is conducted 7 days/week and 52 weeks/year, annual 1999 VOC emissions from tank truck transit are, therefore, divided by 365.

Average Daily 1999 VOC from tank truck transit = (Annual tons of VOC) / (365 days)
= 72.38 / 365
= 0.20 tons/day

3.6.1.4 Summary of Petroleum Product Transport

Table 3-27. Summary of Annual and Season Day Emissions from Petroleum Product Transport

Category	Annual VOC emissions (tons/year)	VOC Season Day emissions (tons/day)
Tank Truck Cleaning	31.76	0.19
Tank Truck Unloading	3,454.53	10.20
Tank Trucks in Transit	72.38	0.20
Total	3,558.67	10.59

3.6.2 Vehicle Refueling

Annual vehicle refueling was calculated using an AP-42 emission factor while daily emissions are based on an emission factor based on grams per gallon for the ozone season calculated by MOBILE 5.0a. The AP-42 emission factor is used since annual emissions are not calculated with MOBILE 5.0a.

As stated in section 3.6.1.2 there is an estimated 1.55×10^9 gallons of gasoline used in the nonattainment area in 1999. Annual VOC is calculated based on the emission factor 10.0 lbs of VOC / 1000 gallons of gasoline (CARB, 1997). This factor is added to the spillage factor of 0.7 lbs of VOC / 1000 gallons of gasoline to obtain an emission factor of 10.7 lbs of VOC / 1000 gallons of gasoline. Also calculated into the equation is Stage II implementation. Based on information provided by Arizona Weights and Measures, Stage II implementation had 90% rule effectiveness, 98% penetration and 95% control efficiency (Arizona, 2001). The following is EPA's rule effectiveness equation (EPA, 1999).

Stage II Implementation factor = (1 – (Rule effectiveness × Control efficiency × Rule penetration)
= 1 – (0.90 × 0.95 × 0.98) = 0.16

Annual emission calculations are shown below.

Annual VOC from vehicle refueling = Annual gasoline use × emission factor × Stage II factor
= (1.55×109 gal) × 10.7 lb/1000 gal × 0.16

= 2,653,600 lbs/yr
= 1,326.80 tons/yr

The amount of gasoline used during the 1999 ozone season in the nonattainment area was 3.66×10^8 gallons. The VOC emission factors for vehicle refueling during the summer (ozone season) were calculated using MOBILE5.0a. The MOBILE 5.0a runs indicate that on an average ozone season day (July–September), the amount of VOC from vehicle refueling is 0.88 g/gallon. This emission factor includes spillage, the effects of RVP, and Stage II full implementation at 100% control efficiency.

The amount of gasoline used daily during the ozone season is calculated by dividing total ozone season VOC by the number of days in the ozone season (7 days/week, 13 weeks/season = 91 days).

$$\text{VOC during the ozone season day} = \frac{\text{Total gas used during ozone season}}{91 \text{ days}} \times \text{emission factor}$$

$$= \frac{3.66\times10^8 \text{ gal}}{91 \text{ days}} \times (0.88 \text{ g/gal})$$

$$= 3.539\times10^6 \text{ g/day} \times (1 \text{ lb}/454 \text{ g})$$

$$= 7{,}796 \text{ lbs/day}$$

$$= 3.90 \text{ tons/day}$$

3.6.3 Service Stations: Breathing & Emptying

The VOC emission factor for underground gasoline tank breathing losses is 1.0 lb/1000 gallons (EPA, Jan. 2001). For this calculation, it is assumed that all gasoline sold in Maricopa County is stored underground.

$$\text{Annual 1999 VOC emissions} = (\text{Gas distributed in county}) \times \text{emission factor}$$

$$= (1.55\times10^9 \text{ gal}) \times (1.0 \text{ lb}/1000 \text{ gal})$$

$$= 1{,}547{,}000 \text{ lbs/yr}$$

$$= 773.50 \text{ tons/yr}$$

Tank breathing losses occur 7 days a week, 52 weeks a year; therefore, the annual 1999 VOC from tank breathing is divided by 365.

$$\text{Average Daily 1999 VOC from tank breathing losses} = (\text{Annual tons of VOC}) / (365 \text{ days})$$

$$= 773.50 \text{ tons} / 365 \text{ days}$$

$$= 2.12 \text{ tons/day}$$

3.6.4 Volatile Organic Liquid (VOL) Storage and Transfer

Sources were located in the EMS database under SICs 5169 or 5199. Emissions in this category are calculated using the software program TANKS3. Daily ozone season emissions were not adjusted for ozone season temperature and true vapor pressure. There are more than 20 chemicals that would need to be adjusted at each source and the resulting refinement of this estimate would have an insignificant impact upon the inventory. Daily ozone season emissions were calculated by multiplying total annual emissions by the seasonal throughput percentage and dividing by the number of days the source operates per week multiplied by 52 weeks per year. Even though this category includes storage, which would be 7 days a week, most of the VOC occurs from the transfer of VOL. Emissions from VOL Storage and Transfer sources are shown in Table 3-28.

Table 3-28. Annual and Season Day VOC Emissions from Volatile Organic Liquid Storage and Transfer

ID #	SIC	Business Name	Annual VOC emissions (tons/yr)	Season Day VOC emissions (lbs/day)
254	5169	Vopak USA Inc	2.61	17.95
499	5169	Columbus Chemical Industries Inc.	1.04	7.99
822	5169	BOC Edwards	3.07	19.47
27940	5169	Tarr Inc.	1.81	27.91
31573	5169	Ashland Distribution Co.	5.69	36.44
36010	5169	Bulk Transportation	0.06	0.45
Total			14.29	110.20

3.6.5 Aircraft Refueling

The amount of fuel used in aircraft refueling is determined by the amount of aircraft fuel used in the nonattainment area. Three types of fuel were used: aviation fuel ("AV-Gas"), Jet Kerosene (JP-8) and Jet Naphtha (JP-4). Annual usage amounts and ozone season usage ratios were determined from annual emission inventories. VOC annual emissions were calculated by facilities using TANKS 3.1 where data was available, or by multiplying throughput with an emission factor calculated using the following equation (EPA 1995).

$$EF = \frac{(12.46 \times S \times P \times M)}{T} \text{ lb/1000 gal}$$

where: EF = emission factor in pounds VOC per 1000 gallons fuel throughput
S = saturation factor
P = fuel true vapor pressure in psia
M = fuel molecular weight in lb/lb·mol
T = temperature of liquid loaded in R (460 + F°)

The season day emissions were calculated by multiplying annual usage by the ozone-season usage percentage and dividing by the number of days operating per week times 13 weeks in the ozone season. Total emissions from this category not reported in the point source section are 57.48 tons VOC/yr and 311 lbs VOC/day.

3.6.6 Local Storage (Airports)

This section includes emission from the loading of underground AV-Gas tanks at local airports. Naphtha and kerosene are piped into the storage tanks at airports so emissions are considered insignificant. Most of the emissions from naphtha are included in the point sources. Breathing losses are also considered insignificant for aircraft fuels considering that they have lower vapor pressures and are less volatile.

The ozone season and annual emissions calculations took into consideration the type of loading as well as temperature of the fuel, true vapor pressure, molecular weight, and control effectiveness (EPA, 1995). The formula used to calculate the emission factor used to determine the annual VOC emissions from controlled balance fill for AV-Gas is shown below (EPA, 1995).

$$EF = \frac{(12.46 \times S \times P \times M)}{T} \times 60\% \text{ efficiency factor}$$

$$= \frac{(12.46 \times 1.0 \times 4 \times 68)}{535} \times 0.60$$

$$= 6.335 \times 0.60$$

$$= 3.8 \text{ lb/1000 gal}$$

where: EF = emission factor in pounds VOC per 1,000 gallons fuel throughput
S = saturation factor (1.0)
P = fuel true vapor pressure in psia (4 at 75°F)
M = fuel molecular weight in lb/lb·mol (68)
T = temperature of liquid loaded in R (460 + 75° F = 535° R)

All AV-Gas loaded into tanks at airports is loaded by truck, so the control effectiveness (40%) is the same as that used in tank truck unloading for gasoline in Section 3.3.4. The formula used to calculate the emission factor used to determine the controlled balance fill ozone season VOC for AV-Gas is shown below (EPA, 1995).

$$EF = \frac{(12.46 \times S \times P \times M)}{T} \times 60\% \text{ efficiency factor}$$

$$= \frac{(12.46 \times 1.0 \times 5.8 \times 68)}{556} \times 0.60$$

$$= 8.84 \times 0.60$$

$$= 5.3 \text{ lbs/1000 gal}$$

where: EF = emission factor in pounds VOC per 1,000 gallons fuel throughput
S = saturation factor (1.0)
P = fuel true vapor pressure in psia (5.8 at 96°F)
M = fuel molecular weight in lb/lb·mol (68)
T = temperature of liquid loaded in R (460 + 96° F = 556 R)

The total amount of AV-Gas used in 1999 was estimated by contacting the three companies that supply fuel to Phoenix Sky Harbor airport as well as from those airports that submitted annual emission reports. The amount was estimated to be 20,159,136 gallons based on the amounts reported to MCESD from these companies (394,452 gallons) and those airports that reported emissions in Section 3.6.5 (19,764,684 gallons). Usage patterns reported in annual emissions reports indicates that 23% of this usage occurs during the ozone season; thus 4.64×10^6 gallons of the fuel is loaded in the summer. The season day emissions are calculated by dividing season emissions by 78 (6 days/week, 13 weeks/season = 78 days).

Annual VOC from AV-Gas tank loading losses $= (20.16 \times 10^6 \text{ gal}) \times (3.8 \text{ lbs/1000 gal})$
$= 76{,}605 \text{ lbs/yr}$
$= 38.30 \text{ tons/yr}$

Daily ozone season VOC from AV-Gas tank loading losses $= (4.64 \times 10^6 \text{ gal} \times 5.3 \text{ lb/1000 gal}) / (6 \times 13)$
$= 315 \text{ lbs/day}$
$= 0.16 \text{ tons/day}$

3.6.7 Bulk Plants Storage and Transfer

Point sources in this category were located in Maricopa County's database under SIC 5171. Emissions in this category were calculated using the emission inventories supplied by the sources. Sources or MCESD used the program TANKS3 to estimate annual emissions. TANKS3 was also used to calculate ozone season day emissions, which were calculated by MCESD using monthly throughput data provided, by each source. Emissions from these sources are shown in Table 3-29. Those facilities that fall into this category and are covered in the point source section are not included below.

Table 3-29. Annual and Season Day VOC Emissions from Bulk Plants Storage and Transfer

ID #	SIC	Business Name	Annual VOC emissions (tons/yr)	Season Day VOC emissions (lbs/day)
2703	5171	Western States Petroleum	2.85	15.64
3597	5171	City of Phoenix Petroleum Stores	3.24	0.00
3701	5171	Brown Evans-B/P #7 & C/L #22	4.29	33.13
39309	5171	Union Distributing Company	2.01	8.90
TOTAL			12.39	57.67

3.6.8 Summary of Storage and Transport

Table 3-30. Summary of Annual and Season Day Emissions from Storage and Transport

Category	Annual VOC emissions (tons/yr)	Season Day VOC emissions (tons/yr)
Petroleum Product Transport	3,558.67	10.59
Vehicle Refueling	1,326.80	3.90
Service Stations: Breathing & Emptying:	773.50	2.12
Organic Chemical Storage and Transport	14.29	0.06
Aircraft Refueling	57.48	0.16
Local Storage (Airports AV-Gas)	38.30	0.16
Bulk Materials Storage and Transport	12.39	0.03
Totals:	**5,781.43**	**17.02**

3.7 Waste Disposal

Emissions from waste disposal, treatment, and recovery processes are grouped into five sections: (1) emissions from on-site incineration sources; (2) emissions from industrial, commercial/institutional, and residential open burning (managed burning); (3) treatment, storage and disposal facilities; (4) landfills; and (5) publicly owned treatment works (wastewater treatment plants).

3.7.1 On-Site Incineration

Three types of incinerators were considered for this section: industrial, commercial/ institutional, and residential. Industrial and commercial institutional incinerator emissions were quantified together from annual emission reports sent to MCESD. They are located at crematories, veterinarian facilities, and electrical wiring reclaim operations. Commercial/ institutional incinerators burn refuse and paper products from wholesale and retail trade establishments, service establishments, and medical waste from hospitals and laboratories. Residential incinerators burn refuse and paper products from homes and apartment complexes with less than 20 units, but none were under County permit in 1999.

All incinerators are required to be permitted by Maricopa County Environmental Services Department (MCESD). A total of 29 commercial/institutional incinerators operated in Maricopa County during 1999 and they were not considered in the point source section. The data used to calculate emissions from incinerators were obtained from each source's 1999 emissions report submitted to MCESD. MCESD require sources to submit annual reports on emissions from processes and/or materials used at each source and these were used to determine annual emissions for each source. An example of this report is in Appendix 3-2.

Based on the operating schedule shown on each source's emissions report, it is determined that incinerators operated roughly uniformly throughout 1999. To calculate season day emissions, annual emissions were divided by 65, based on an average operating schedule of five days a week for the 13-week season, as reported by most facilities. The calculation below illustrates 1999 season day emissions.

$$\text{VOC Emissions (lbs/day)} = \frac{\text{emissions (lbs)}}{\text{days/week}} \times \frac{\text{seasonal factor}}{\text{weeks/season}}$$

$$\text{Season Day VOC emissions} = \frac{626 \text{ lbs} \times 0.25}{5 \text{ days/week} \times 13 \text{ weeks/season}} = 2.41 \text{ lbs/day} = 0.001 \text{ tons/day}$$

Table 3-31. Annual and Season Day Emissions from On-site Incineration

Pollutant	Annual Emissions (tons/yr)	Season Day Emissions (tons/day)
VOC	0.31	0.00
NO_x	10.34	0.04
CO	0.44	0.00

3.7.2 Industrial, Commercial/Institutional, and Residential Open Burning

This section includes emissions from controlled open burning, which is regulated by MCESD Rules and Regulations. MCESD issues the required burning permits primarily for purposes of agricultural ditch bank and fencerow burning, tumbleweed burning, land clearance, and air curtain destructor burning of trees. Amount of materials burned is estimated using data from earthmoving permits issued in 1999. Calculations are made for each type of burning, which are then summed to derive total emissions in this category. The emission and loading factors used are shown in Table 3-32 and a summary of the burning permit data is shown in Table 3-33.

Table 3-32. Emission Factors and Fuel Loading Factors for Open Burning of Agricultural Materials

Refuse Category	Emission Factors (lb/ton burned) CO[1]	NO_x[2]	VOC[1]	Fuel Loading Factors[1] (waste production, tons/acre)
Weeds, unspecified	85	4	9	3.2
Russian Thistle (Tumbleweeds)	309	4	1.5	0.1
Orchard Crops: Citrus	81	4	9	1.0

[1] AP-42, Table 2.5-5.
[2] AP-42, Table 2.5-5 footnote.

Table 3-33. County Burn Permit Data Used to Estimate Material Quantities Burned

Type of Burning	Amount Burned: Annual 1999	Amount Burned: Ozone Season (July–September)
Ditch Banks and Fence Rows	5,935,448 feet	Not allowed
Tumbleweeds	2,155 piles	32 piles
Land Clearance	6,397 acres + 59 piles	66 acres + 24 piles
Air Curtain Destructors	4,044 citrus trees	1,040 trees
Pest Prevention	55 acres	55 acres

3.7.2.1 Burning of Agricultural Ditch Banks and Fence Rows

According to investigators at MCESD, ditch width ranges from 5 to 10 feet, fence rows are about 4 feet, and burning occurs at least twice a year. Since there is no data kept regarding this delineation, an average 7-foot width was assumed, with an equal prevalence of ditch banks and fencerows. The total permitted length was assumed to be within the nonattainment area.

To calculate the amount of material burned on ditch banks and fencerows in Maricopa County, MCESD estimated the area burned and multiplied that by the fuel loading factor (listed in Table 3-33) which relates acres to tons of material. The tons of material burned in ditch banks and fencerows burned in Maricopa County were estimated as follows:

$$\text{Total tons of unspecified weeds burned for ditch bank and fence row clearing} = \frac{5{,}935{,}448 \text{ ft length} \times 7 \text{ ft width}}{43{,}560 \text{ ft}^2 / \text{acre}} \times 3.2 \text{ tons/acre} \times 2 \text{ times/year}$$

$$= 6{,}104.4 \text{ tons weeds burned/yr}$$

Annual emissions for agricultural burning of ditch banks and fencerows (DBFR) are calculated according to the following formula:

$$\text{Annual DBFR emissions} = \text{emission factor} \times \text{tons burned}$$
$$= (85 \text{ lb CO/ton burned}) \times (6{,}104.4 \text{ tons burned})$$
$$= 518{,}874 \text{ lb CO/yr}$$
$$= 259.44 \text{ tons CO/yr}$$

We assume this type of routine agricultural burning is conducted equally throughout the available burning season (March - October), approximately 35 weeks of the year. The seasonal adjustment factor is determined as follows:

$$\text{Seasonal adjustment factor} = \frac{\text{July-September Activity Level}}{\text{Total Activity Level}} = \frac{13 \text{ weeks}}{35 \text{ weeks}} = 0.37$$

Agricultural burning during the peak ozone season emissions occurs five days per week. Average daily emissions are calculated as follows:

$$\text{Average Daily Ozone Season emissions (lb)} = \frac{(\text{Annual Emissions lbs}) \times (\text{Seasonal Adjustment Factor})}{(\text{Operation, days/week}) \times (\text{Season, weeks/yr})}$$

$$\text{Example: Average Daily Ozone Season CO emissions} = \frac{518{,}874 \text{ lb} \times 0.37}{5 \times 13}$$

$$= 2{,}954 \text{ lb/day}$$

$$= 1.48 \text{ tons/day}$$

Table 3-34 shows emission factors and estimated annual and daily emissions for ditch bank and fencerow burning in the nonattainment area.

Table 3-34. Annual and Season Day Emissions for Ditch Bank and Fence Row Burning

	Emission factor for "Unspecified Weeds" (lbs/ton burned)	Annual Emissions		Average Daily Ozone Season Emissions	
		Lbs	Tons	Lbs	Tons
VOC	9	54,940	27.47	313	0.16
NO_x	4	24,418	12.21	139	0.07
CO	85	518,874	259.44	2,954	1.48

3.7.2.2 Burning of Tumbleweeds

Permittees are required to pile tumbleweeds before burning. Tumbleweed burning permittees specify "amount of burning" in either acres or piles. A pile of tumbleweeds 15' diameter and five feet high was estimated by the Maricopa County/U of A Cooperative Extension Service to weigh 200 lb (MCESD, 1993). This is the same as the AP-42 fuel loading factor for 1 acre. It is assumed "best guess" that one acre of tumbleweeds would indeed yield one pile of the stated dimensions.

In 1999, it was estimated that 2,155 piles of tumbleweeds were burned in the Maricopa County nonattainment area. Using the AP-42 fuel loading factor of 0.1 ton/acre for Russian thistle (tumbleweed), the total weight burned is calculated as follows: 2,155 acres × 0.1 tons/acre = 215.50 tons/yr. Tumbleweed burning permits are valid for one month only. In 1999, there were 1,204 acres were permitted during the months of June through August. Burning was considered to have occurred evenly during the ozone season months. In the same manner as above, the total weight burned is estimated at (1,204 acres × 0.1 tons/acre = 120.40 tons burned). VOC season emissions from burning tumbleweed are calculated as follows:

VOC season emissions = tons burned × emission factor
= 120.40 tons × 1.5 lbs VOC/ton = 180.60 lb VOC

Burning is normally allowed only on the five weekdays. Season daily emissions were calculated according to the following example:

$$\text{Season Daily VOC emissions (lb)} = \frac{\text{Seasonal Emissions lb}}{\text{(season operation, days)}} = \frac{180.60 \text{ lb VOC}}{65 \text{ days/Ozone season}} = 2.78 \text{ lb/day}$$

Table 3-35. Annual and Season Day Emissions for Tumbleweed Burning

	Emission factor (lbs/ton burned)	Annual Emissions		Average Daily Ozone Season Emissions	
		Lbs	Tons	Lbs	Tons
VOC	1.5	323	0.16	3	0.00
NO_x	4	860	0.43	7	0.00
CO	309	66,590	33.29	572	0.29

3.7.2.3 Burning of Trees

The Maricopa County/U of A Extension Service Agricultural Agents (MCESD, 1993) estimated the weight of citrus trees to be 500 lb/tree, assuming trees were mature, partially dried and included trunk, limbs and bulk of roots. In 1999, three burn permits were issued for 4,044 trees in the Maricopa County nonattainment area. Using the fuel loading factor provided by the agricultural agents, the total weight burned is calculated to be 1,011 tons.

(500 lb/tree) × (4,044 trees) × (1 ton/2,000 lb) = 1,011 tons

No emission factors are available for air curtain destructor burning of trees. Citrus tree emission factors from the AP-42 "Open Burning" section were used.

Example:

VOC Emissions from burning trees = Emission factor × tons of wood
= 9 lb VOC/ton × 1,011 tons
= 9,099 lbs/yr
= 4.55 tons/yr

Since these tree burning permits are valid for only one month, average daily ozone season emissions are estimated based on the permits issued during June, July, and August. During the July-September ozone season, permits to burn a total of 3,004 trees were issued. It was assumed the burning occurred over the three-month season, seven days a week. The ozone daily season emissions are calculated as follows:

Ozone season burned trees = (500 lb/tree) × (3,004 trees) × (1 ton/2,000 lb) = 751 tons

1999 VOC season daily emissions from burning trees = 751 tons × 9 lb/ton = $\frac{6{,}759 \text{ lbs VOC}}{91 \text{ days/season}}$ = 74.27 lbs VOC/day

Table 3-36. Annual and Season Day Emissions for Tree Burning

	Emission factor (lbs/ton burned)	Annual Emissions		Average Daily Ozone Season Emissions	
		Lbs.	Tons	Lbs.	Tons
VOC	9	9,099	4.55	74	0.04
NO_x	4	4,044	2.02	33	0.02
CO	81	81,891	40.95	900	0.45

3.7.2.4 Burning for Land Clearance

Materials burned for land clearance are comprised of assorted brush, grasses and some tree waste. Tree limbs and trunks larger than 6" in diameter are required to be removed. The natural vegetation of the area is desert, so we assume the vegetation burned can be appropriately described as "unspecified weeds" for choosing fuel loading and emission factors.

According to the burn permit database, 6,397 acres were burned for land clearance in 1999, plus 59 piles. Assuming a pile is equivalent to an acre, as is the case with tumbleweed, a total equivalent of 6,456 acres was burned. Using the AP-42 fuel loading factor of 3.2 tons/acre for "unspecified weeds," the weight burned was calculated as:

Tons of "unspecified weeds" burned for land clearance = 6,456 acres × 3.2 tons/acre
= 20,660 tons

Table 3-37 shows the AP-42 emission factors used to calculate emissions from land clearance burning. An example emission calculation is provided below.

Tons of CO from burning for land clearance = tons burned × emission factor
= 20,660 tons × 85 lb CO/ton
= 1,756,100 lb CO
= 878.05 tons/yr

Two land clearance burn permits were issued during August 1999. Burn permits for land clearance expire in one month, so it is assumed that the total acreage of the two permits, 5,600 acres, were burned over 4 weeks, 5 days per week.

Tons of "unspecified weeds" burned for land clearance = 5,600 acres × 3.2 tons/acre
= 17,920 tons

Thus daily emissions were calculated as:

Daily CO emissions from land clearance = 17,920 tons × 85 lb CO/ton/ 20 days = 76,160 lbs CO/day

Table 3-37. Annual and Season Day Emissions from Land Clearance Burning

	Emission factor (lbs/ton burned)	Annual Emissions		Average Daily Ozone Season Emissions	
		Lbs	Tons	Lbs	Tons
VOC	9	185,940	92.97	8,064	4.03
NO_x	4	82,640	41.32	3,584	1.79
CO	85	1,756,100	878.05	76,163	38.08

3.7.2.5 Pest Prevention Burning

Pest prevention burning is comprised of assorted agricultural crops. One permit for 55 acres was issued in 1999. Since the crop was not described, an average fuel-loading factor from "unspecified field crop" and "unspecified orchard crop" of 1.8 tons/acre was used.

55 acres × 1.8 tons/acre = 99 tons crop

The emission factors used to calculate emissions from pest prevention burning was averaged from the fore-mentioned categories. The permit, only valid for one month, was not issued during the ozone season.

Total 1999 VOC emissions from burning for pest prevention = tons burned × emission factor
= 99 tons × 13 lb/ton = 1,287 lb VOC = 0.64 tons VOC/yr

Total 1999 NO_x emissions from burning for pest prevention = tons burned × emission factor
= 99 tons × 4 lb/ton = 396 lb NO_x = 0.20 tons NO_x/yr

Total 1999 CO emissions from burning for pest prevention = tons burned × emission factor
= 99 tons × 84.5 lb/ton = 8,366 lb CO = 4.18 tons CO/yr

3.7.2.6 Summary for Open Burning

Total emissions from open burning are obtained by adding the emissions from each type of burning. The results are shown in Table 3-38.

Table 3-38. Summary of Annual and Season Day Emissions From Open Burning

Type of Burning	VOC tons/yr	VOC tons/day	NO_x tons/yr	NO_x tons/day	CO tons/yr	CO tons/day
Ditch banks and fence rows	27.47	0.16	12.21	0.07	259.44	1.48
Tumbleweeds (Russian thistle)	0.16	0.00	0.43	0.00	33.29	0.29
Trees (citrus)	4.55	0.04	2.02	0.02	40.95	0.43
Land clearance (unspecified weeds)	92.97	4.03	41.32	1.79	878.05	38.08
Pest prevention burning	0.64	–	0.20	–	4.18	–
Totals:	125.79	4.23	56.18	1.88	1,215.91	40.28

3.7.3 Publicly Owned Treatment Works (Wastewater Treatment Plants)

Emissions from wastewater treatments plants (SIC code 4952, NAICS code 22132) were identified from the annual emissions survey. Two facilities (91st Ave. WWTP and the City of Phoenix 23rd Ave. facility) were addressed in the point source section.

Table 3-39. Summary of Annual and Season Day Emissions from Wastewater Treatment Plants

Facility	VOC tons/yr	VOC lbs/day
157th Ave. Water Reclamation Plant	0.54	3
Chandler Ocotillo Water Reclamation Plant	0.70	7
Totals:	1.24	11

3.7.4 Treatment, Storage and Disposal Facilities

This section includes VOC, NO_x and CO emissions from facilities in SIC 4953, but which are not municipal landfills. It is assumed that there are no significant unpermitted sources in this category in the non-attainment area. The totals below were obtained from annual emissions reported submitted by each facility.

Table 3-40. Summary of Emissions from Treatment, Storage and Disposal Facilities

	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
Totals:	1.83	22	1.57	10	0.34	2

3.7.5 Municipal Landfills

There are seven landfills within the non-attainment area that are considered area sources. (One additional landfill is addressed in the point source section). The emissions were estimated using annual emissions reports. Season day emissions were calculated by multiplying annual emissions by reported seasonal percentage operations and dividing by reported operating days per week and 13 weeks in the ozone season. Table 3-41 shows a summary of emissions from landfills in the nonattainment area.

Table 3-41. Summary of Emissions from Landfills

	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
Totals:	17.03	107	28.24	168	36.33	205

3.7.6 Summary of Waste Disposal

Table 3-42. Summary of Annual and Season Day Emissions from Waste Disposal

Category	VOC tons/yr	VOC tons/day	NO_x tons/yr	NO_x tons/day	CO tons/yr	CO tons/day
On-Site Incineration	0.31	0.00	10.34	0.04	0.44	0.00
Industrial, Commercial/Institutional and Residential Open Burning	125.79	4.23	56.18	1.88	1,215.91	40.28
Publicly Owned Treatment Works	1.24	0.01				
Treatment, Storage and Disposal Facilities	1.83	0.01	1.57	0.01	0.34	0.00
Municipal Landfills	17.03	0.05	28.24	0.08	36.33	0.10
Total Waste Disposal Emissions:	**146.20**	**4.30**	**96.33**	**2.01**	**1,253.02**	**40.38**

3.8 Miscellaneous

3.8.1 Leaking Underground Storage Tanks

1993 emissions estimates for this category were used to estimate emissions in 1999 (MCESD, 1993). The data kept in the MCESD soil remediation database has been extended to include outlet of VOC emissions in lbs/day, however the data is grossly incomplete. Based on current database entries, only eight sources reported, with total annual VOC emissions at 2 tons/yr. Therefore the County has decided to retain data from the earlier inventory as a conservative approach for estimating emissions from this category.

Annual VOC Emissions from Leaking Underground Storage Tanks = 192.80 tons/yr
Ozone Season Day VOC from Leaking Underground Storage Tanks = 0.74 tons/day

3.8.2 Catastrophic/Accidental Release

3.8.2.1 Emissions from Forest Fires

The Arizona State Land Department provided the number of wildfires that occurred in and around Maricopa County in 1999. Thirty-three wildfires occurred, burning a total of 192 acres. The following EPA emission factors are used to calculate the emissions. (EPA, 1996) The emission factors include the fuel-loading factors.

VOC emission factor = 269 kg/hectare or 239.5 lb/acre
NO_x emission factor = 45 kg/hectare or 40.1 lb/acre
CO emission factor = 1570 kg/hectare or 1397.8 lb/acre

CO emissions 192 acres $\times$ 1397.8 lb/acre = 268,380 lbs CO/yr or 134.19 tons CO/yr

It was assumed that the fires occurred evenly throughout the year for calculating season day emissions.

$$\text{CO daily emissions} = \frac{268{,}380 \text{ lbs/yr} \times 0.25}{91 \text{ days}} = 737.3 \text{ lbs CO/day or } 0.37 \text{ tons CO/day}$$

Table 3-43. Emission Factors for Brush Fires

Pollutant	Emission Factor (lb/acre)	Annual Emissions (tons/yr)	Ozone Season Day Emissions (tons/day)
VOC	239.5	22.99	0.06
NO_x	40.1	3.85	0.01
CO	1,397.8	134.19	0.37

3.8.2.2 Structure, Motor Vehicle, and Brush Fires

This section includes emissions from structure and motor vehicle fires. Data was compiled by a survey to all fire departments in the nonattainment area, a complete list of which was obtained from the Arizona Department of Emergency Services. The letter and survey form to the directors of these fire departments is included in Appendix 3-3. The numbers of structural, vehicle, and brush fires during the 1999 calendar year was requested. Eighteen permits obtained for fire training were included in the number of structure fires. For stations that did not return the survey, 1996 information was used. It is important to note that these emissions may be overstated because the fire data may only represent a partial burn.

Estimates of the material burned in a structure fire are obtained by multiplying the number of structure fires by a fuel loading factor of 1.15 tons of material per fire, which factors in percent structural loss and content loss (EPA, July, 1999).

The automobile fire emission factors listed below are a composite developed from factors in Tables 2.2-1 and 2.4-1 of AP-42, and reflect average car body weight and components, and assuming 60% of the fires included tires. Table 2.2-1 of AP-42 lists emission factors for the incineration of stripped automobiles ("EF body") and Table 2.4-1 list emission factors for the burning of automobile components ("EF components"). All emission factors were derived as in the following example calculation:

Composite Emission Factor lb/car = $0.6 \times$ (EF body + EF components) + $0.4 \times$ EF body

Assuming that there are 500 lbs of components on an automobile (0.25 tons components/car) with a 3,700-lb body, then the CO emission factor for components (125 lb/ton from Table 2.4-1 in AP-42) is multiplied by 0.25. This results in an emission factor of 31.25 lb/car, which is used as the "EF components" factor in the above equation. The "EF body" emission factor is taken directly from Table 2.2-1. Thus:

Composite Emission Factor lb/car = $0.6 \times (2.5 + 31.25) + (0.4 \times 2.5) = 21.25$ lb CO/car

The emission factors for vegetation burned were identical to those used for "unspecified weeds" in Section 3.7.2. Vegetation burned includes fences, alley, trash, and yard fires of accidental occurrence for which local fire departments have records. As the average size of the fires is unknown, it was assumed to be equal to 0.1 acres.

Table 3-44. Emission Factors for Structure, Motor Vehicle, and Brush Fires

Type of Fire	Number of Fires	Fuel Loading Factor	CO Emission Factor (lb/ton)	NO_x Emission Factor (lb/ton)	VOC Emission Factor (lb/ton)
Structure	3,769	1.15 tons/structure	60	1.4	11
Automobile	4.901	N/A	21.25 lb/car	0.7 lb/car	5.3 lb/car
Brush	6,967	3.2 tons/acre	85	4	9

As no seasonal data on brush fires is available, fires are assumed to occur equally throughout the year, and throughout a seven-day week. Therefore, the total emissions per year for each category are divided by 365 to estimate season day emissions.

Example:

Annual CO emissions from structure fires = (no. fires) × (fuel loading factor) × (CO emission factor)
= 3,769 × 1.15× 60
= 260,061 lbs/yr
= 130.03 tons/yr

Table 3-45. Annual and Average Daily Ozone Season Emissions from Structure, Motor Vehicle, and Brush Fires

Category	VOC tons/yr	VOC tons/day	NO_x tons/yr	NO_x tons/day	CO tons/yr	CO tons/day
Structure Fires	23.84	0.01	2.64	0.001	130.03	0.06
Motor Vehicle Fires	12.99	0.01	1.72	0.001	52.07	0.03
Brush Fires	10.03	0.005	4.46	0.002	94.75	0.05
Total	46.86	0.025	8.82	0.004	276.85	0.14

3.8.2.3 Fire Fighting Training

The 1999 annual emissions for fire fighting training were included as structure fires in Table 3-45.

3.8.3 Repair Shops

Emissions from this category were not calculated separately. Instead, these emissions are incorporated in other sections, point sources, industrial processes and other solvent usage.

3.8.4 Health Services

The 1999 emissions for health services were obtained from the annual emission reports submitted by these facilities with Tier Codes 080699 or 140599. Total annual VOC emissions were 19.59 tons. Ozone season day emissions, calculated using summer seasonal percentage and days of operation, were 0.06 tons/day. Total employment reported by point and area sources facilities was comparable to employment data obtained from the County Business Patterns website. Thus it was assumed that there are no significant unpermitted sources in this category.

3.8.5 Summary of Miscellaneous Area Sources

Table 3-46. Annual and Average Daily Ozone Season Emissions from Other Area Sources

Category	VOC tons/yr	VOC tons/day	NO_x tons/yr	NO_x tons/day	CO tons/yr	CO tons/day
Leaking Underground Storage Tanks	192.80	0.74				
Wild Fires	22.99	0.06	3.85	0.01	134.19	0.37
Structure Fires	23.84	0.01	2.64	0.00	130.03	0.06
Motor Vehicle Fires	12.99	0.01	1.72	0.00	52.07	0.03
Brush Fires	10.03	0.01	4.46	0.00	94.75	0.05
Repair Shops	0	0	0	0	0	0
Health Services	19.59	0.06				
Total Other Area Source Emissions:	282.24	0.89	12.67	0.01	411.04	0.51

3.9 Summary of All Area Source Emissions

Table 3-47. Summary of All Area Source Annual and Season Day Emissions by Category

Category / Subcategory	VOC tons/yr	VOC tons/day	NO_x tons/yr	NO_x tons/day	CO tons/yr	CO tons/day
External Combustion Sources:						
Industrial Fuel Oil Combustion	122.51	0.39	1,502.62	4.82	323.40	1.04
Industrial Natural Gas Combustion	15.30	0.05	278.18	0.86	233.67	0.72
Commercial/Institutional Fuel Combustion	22.72	0.06	413.16	1.06	347.05	0.88
Residential Fuel Combustion	2,027.76	0.38	704.07	0.81	2,510.61	0.71
Category Totals:	2,188.29	0.88	2,898.03	7.55	3,414.73	3.35
Internal Combustion Sources:						
Industrial Natural Gas Combustion	13.44	0.04	329.16	1.01	46.24	0.14
Commercial/Institutional Natural Gas	190.85	0.53	4,388.53	12.05	742.41	2.04
Category Totals:	204.29	0.57	4,717.69	13.06	788.65	2.18
Industrial Processes:						
Plastic Product and Rubber Manufacturing	115.05	0.47				
Pharmaceutical Manufacturing	3.50	0.02				
Agriculture, Food & Kindred Products	313.54	1.02				
Wood, Pulp & Paper, & Publishing Products	0.0	0.0				
Mineral Products	33.45	0.13				
Electronic Equipment	6.57	0.03				
Miscellaneous Industrial Processes	142.83	0.66				
Category Totals:	614.94	2.33	0.0	0.0	0.0	0.0
Solvent Utilization:						
Degreasing	101.83	0.37				
Graphic Arts	348.43	1.28				
Dry Cleaning	32.90	0.13				
Surface Coating:						
-Large Appliances and Other Appliances	1.65	0.01				
-Metal Coils, Sheets, and Strips	161.18	0.62				
-Paper/Fabric	35.64	0.14				
-Wood Furniture	140.44	0.56				
-Factory Finished Wood	26.68	0.10				
-Miscellaneous Finished Metals	156.40	0.60				
-Plastic Products	35.31	0.15				
-Marine	90.15	0.35				
-Railroad	4.36	0.02				
-Machinery and Equipment	66.07	0.25				
-High Performance Maintenance Coatings	30.65	0.11				
-Other Special Purpose Coatings	19.60	0.07				
-Metal Furniture	1.50	0.01				
-Other Surface Coating	177.42	0.61				
Non-industrial Surface Coating:						
-Architectural Coatings	6,801.44	18.63				
-Automobile Refinishing	264.36	1.02				
-Traffic Markings	137.45	0.44				

Table 3-47. Summary of All Area Source Annual and Season Day Emissions by Category (continued)

Category / Subcategory	VOC tons/yr	VOC tons/day	NO_x tons/yr	NO_x tons/day	CO tons/yr	CO tons/day
Other Solvent Utilization:						
-Asphalt Paving	1,857.73	7.15				
-Commercial/Consumer Solvent Use	8,960.16	24.55				
-Pesticide Application	3,046.26	7.47				
-Other	97.95	0.38				
Category Totals:	22,595.56	65.02	0.0	0.0	0.0	0.0
Storage and Transport:						
Petroleum & Petroleum Product Transport:						
–Tank Truck Cleaning	31.76	0.19				
–Tank Truck Unloading	3,454.53	10.20				
–Tank Trucks in Transit	72.38	0.20				
–Vehicle Refueling	1,326.80	3.90				
Service Stations: Breathing & Emptying	773.50	2.12				
Volatile Organic Liquid Storage and Transfer	14.29	0.06				
Aircraft Refueling	57.48	0.16				
Local Storage (Airport AV-Gas)	38.30	0.16				
Bulk Plants Storage and Transfer	12.39	0.03				
Category Totals:	5,781.43	17.02				
Waste Disposal:						
On-Site Incineration	0.31	0.00	10.34	0.04	0.44	0.00
Industrial, Commercial/Institutional and Residential Open Burning	125.79	4.23	56.18	1.88	1215.91	40.28
Publicly Owned Treatment Works	1.24	0.01				
Treatment, Storage and Disposal Facilities	1.83	0.01	1.57	0.01	0.34	0.00
Municipal Landfills	17.03	0.05	28.24	0.08	36.33	0.10
Category Totals:	146.20	4.30	96.33	2.01	1253.02	40.38
Miscellaneous:						
Leaking Underground Storage Tanks	192.80	0.74				
Catastrophic/Accidental Release:						
–Wild Fires	22.99	0.06	3.85	0.01	134.19	0.37
–Structure Fires	23.84	0.01	2.64	0.00	130.03	0.06
–Motor Vehicle Fires	12.99	0.01	1.72	0.00	52.07	0.03
–Brush Fires	10.03	0.01	4.46	0.00	94.75	0.05
Health Services	19.59	0.06				
Category Totals:	282.24	0.89	12.67	0.01	411.04	0.51
Area Source Totals:	**31,812.95**	**91.01**	**7,724.72**	**22.63**	**5,867.44**	**46.42**

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SECTION 4. NONROAD MOBILE SOURCES

4.1 Introduction and Scope

The nonroad mobile source emissions inventory includes aircraft, locomotives, diesel equipment, 4-stroke gasoline equipment, and 2-stroke gasoline equipment. Aircraft activity at unpaved airports is not accounted for in this inventory because the activity is considered insignificant. There are no coal-burning locomotives in the non-attainment area. Emissions from off-road equipment such as snowplows and snowmobiles were not included because the Phoenix area does not receive enough snow. Commercial marine vessels were not included since there are no navigable bodies of water suitable. There was only negligible activity for recreational marine vessels within the nonattainment area; therefore no emissions were quantified.

Aircraft emissions were calculated using survey information provided by the airports and incorporating these data into the EPA's FAA Aircraft Engine Emissions Database (FAEED). Survey information was also used for calculating locomotive emissions. Emission estimates for diesel equipment, 4-stroke and 2-stroke gasoline equipment sources were developed using the Energy and Environmental Analysis, Inc. study prepared for EPA's Office of Mobile Sources (OMS). Nonroad gasoline equipment includes recreational vehicles, construction equipment, industrial/commercial equipment, lawn and garden equipment, and farm equipment. Nonroad diesel equipment includes the same equipment, minus the lawn and garden equipment. These emissions estimates were adjusted to reflect growth and conditions specific to the nonattainment area as explained in section 4.4.

Nonroad emission calculations include 1999 annual and average daily ozone season CO, NO_x, and VOC. Conversion factors found in the guidance document (EPA, 1992) were used to convert hydrocarbons (HC) to VOC for aircraft. Hydrocarbon speciation data were used to calculate VOC from HC data reported for diesel locomotives. Methane and ethane contributions were subtracted from HC values for the combustion of diesel fuel in reciprocating diesel fuel engines (Radian Corp.).

4.2 Procedures for Estimating Emissions from Aircraft

Emission factors for estimating aircraft emissions were determined using the FAA Aircraft Engine Emissions Database (FAEED). Airport operations data for 1999 were collected from the airports through surveys sent by mail. All airports except Stellar Aviation responded, therefore 1996 operation numbers were used for Stellar Aviation. Table 4-1 shows those general aviation airports included in this inventory and the number of operations. The number of operations is defined as a landing or a take-off, while an LTO is a landing and take-off cycle. Therefore, the number of airport operations is divided by two to calculate the number of LTOs.

Table 4-1. Airports and Operation Data

Airport	1999 Operations	1999 LTOs
Chandler Municipal Airport	221,018	110,509
Stellar Aviation	60,000	30,000
Glendale Municipal Airport	130,055	65,028
Phoenix Goodyear Airport	136,278	68,139
Luke Air Force Base	168,520	84,260
Mesa Falcon Field Airport	263,988	131,994
Deer Valley Airport	290,791	145,396
Scottsdale Airport	230,571	115,286
Phoenix Sky Harbor	557,458	278,729
Williams Gateway Airport	236,278	118,139
Total	**2,294,957**	**1,147,480**

4.2.1 Emission Factors

The alternative fleet-average method, outlined in Procedures for Emission Inventory Preparation Volume IV: Mobile Sources (EPA, 1992), was used to calculate emissions for all types of aircraft and the emission factors are shown below in Table 4-2. For this method, the emission factors for all unique engines in a certain aircraft type category were averaged. When there was more than one type of engine for a specific aircraft, the engine having maximum CO emissions at idle was used. Emission factors were then back calculated by taking emission estimates from FAEED and dividing by LTO cycles. For this method, the emission factors for all unique engines in a certain aircraft type category were averaged since they were reported together in FAEED.

Table 4-2. Aircraft Emission Factors

Aircraft Type	HC Multiplier for VOC	lbs VOC/ LTO	lbs NO_x/ LTO	lbs CO/ LTO
Air Carrier	1.0947	3.57	62.33	17.25
Air Taxi	1.0947	13.17	32.83	36.32
General Aviation Single-Engine Piston	0.9649	0.41	0.06	25.55
General Aviation Single-Engine Turboprop	1.0631	0.12	0.03	7.87
General Aviation Multiple-Engine Piston	0.9649	1.13	0.04	89.72
General Aviation Multiple-Engine Turboprop	1.0631	2.20	0.43	18.92
General Military	1.1046	77.84	21.43	83.87
Military F-16s	1.1046	0.66	10.46	21.06
Helicopters	0.9708	2.99	2.02	5.43

Data on specific air carrier operations from 1999 and aircraft type information for 1998 from Phoenix Sky Harbor was used for these emission factors. Air taxi emission factors were determined using aircraft type information in FAEED for long- and medium-range jets by using all unique engines once and then dividing by the number of engines. General aviation emission factors were determined using the aircraft type information in FAEED for the five different categories of general aviation: single engine piston, multi-engine piston, single engine turboprop, multi-engine turboprop, and helicopters. General military emission estimates were determined as a fleet average using all military aircraft in FAEED except fighter jets. As F-16 aircraft comprise most of Luke Air Force Base's airport operations, those emissions were calculated using FAEED. No emission factors were available for the business jet category, so the air carrier emission factor was used, and emissions were included under general aviation.

4.2.2 Summary of Aircraft Emissions

The FAEED model was used to generate emission factors for this inventory. Emissions and emission factors for CO, NO_x, and HC are obtained and then VOC is calculated from HC using conversion data (EPA, 1992, p. 198). Table 4-3 presents the annual and daily emissions estimated by aircraft type and airport. To calculate general aviation emissions, the percentage of each type of aircraft was estimated from information provided by the airports in the MAG Aviation Air Quality Survey for Airports (MAG, 1996).

Phoenix Sky Harbor airport's summer activity, June through August, was 24.6% of the total annual activity. This was used in calculation of the season day emissions for Sky Harbor only. Other airport summer activity was calculated according to percentage of second quarter activity, which was provided in the surveys. Example calculations for Sky Harbor follow the table.

4.2.3 Examples

Phoenix Sky Harbor Airport provided the following operations data for 1999 and aircraft type information from 1998.

Type	No. of 1999 Operations
Air Carrier	475,627
General Aviation	77,375
Military	4,456

Air taxi and helicopter operations were included with the air carrier operations. The three monthly reports provided by the airport separated out air taxi operations. The average percentage of air taxi operations from these reports was 19%; therefore there are 90,369 air taxi operations. In addition, 7.5%, or 35,672 of reported total air carrier operations are helicopter operations. Unlike the other airports, the information Phoenix Sky Harbor provided was sufficient to create an air carrier aircraft-specific model using FAEED. Results are shown in Appendix 4-1.

Table 4-3. Annual and Season Day Emissions from Aviation

Airport	Aircraft Type	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
Carefree/ Chandler	Air Taxi	4.7	24	11.8	60	13.0	66
	General Aviation	29.5	150	4.8	24	1,818.5	9,272
	Military	2.0	10	0.5	3	2.0	10
Deer Valley	General Aviation	40.4	195	64.8	313	2,294.0	11,086
	Military	11.4	55	2.9	14	11.4	55
Glendale	Air Taxi	3.8	21	9.5	52	10.5	58
	General Aviation	7.8	43	0.9	5	515.0	2,830
Goodyear	Air Carrier	1.0	5	17.5	89	4.8	25
	General Aviation	16.7	85	2.0	10	1,076.7	5,514
	Military	2.5	13	0.6	3	2.5	13
Luke AFB	Air Carrier/Taxi	7.1	40	40.1	226	22.6	126
	General Aviation	2.9	16	0.4	2	105.8	591
	Military	25.1	142	397.1	2,243	799.4	4466
Falcon Field	Air Carrier	0.0	0	0.7	3	0.2	1
	Air Taxi	10.9	51	27.2	127	30.1	141
	General Aviation	44.1	206	17.1	80	1,823.6	8,537
	Military	208.2	974	53.2	249	208.2	974

Table 4-3. Annual and Season Day Emissions from Aviation (continued)

Airport	Aircraft Type	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
Phoenix Sky Harbor Int'l.	Air Carrier	312.4	1,689	5,450.6	29,469	1,508.2	8,154
	Air Taxi	80.5	435	1,405.5	7,599	388.9	2,103
	General Aviation	40.0	217	26.9	145	750.4	4,057
	Military	93.4	505	23.9	129	93.4	505
Scottsdale	Air Taxi	23.8	115	59.4	285	65.6	316
	General Aviation	47.3	228	217.7	1,048	2,109.6	10,154
	Military	9.6	46	2.4	12	9.6	46
Stellar	General Aviation	7.9	43	1.9	11	406.4	2,233
Williams	Air Carrier	1.0	5	16.8	79	4.7	22
	Air Taxi	15.2	72	37.9	178	41.9	197
	General Aviation	42.0	198	80.4	378	2,734.6	12,862
	Military	934.9	4,397	238.9	1,123	934.9	4,397
Totals:		**2,026.0**	**9,980**	**8,213.4**	**43,960**	**17,786.5**	**87,910**

For the general aviation category, aircraft type information from the MAG Aviation Survey conducted in 1994 was used to split the category into business jets, single-engine piston, multi-engine piston, single-engine turboprop, and multi-engine turboprop based on percentage of LTOs of each type of aircraft. Operations for 1999 were then further split as shown in Table 4-4.

Table 4-4. Phoenix Sky Harbor Airport: 1999 Operations

Type	1999 Operations	1999 LTO Cycles
Air Carrier	349,586	174,793
Air Taxi	90,369	45,184
Helicopters	35,672	17,836
General Aviation:	77,375	38,688
–Business Jet	464	232
–Single-engine Piston	57,412	28,706
–Multi-engine Piston	13,618	6,809
–Single-engine Turboprop	0	0
–Multi-engine Turboprop	5,881	2,941
Military	4,456	2,228
Totals:	557,458	278,729

4.2.3.1 Phoenix Sky Harbor Air Carrier

The following emission factors were determined by using the FAEED model. The inputs were the number of aircraft LTO cycles by aircraft type using 1999 operations (minus helicopters) and 1998 aircraft type supplied by Sky Harbor (Appendix 4-2). HC emissions were multiplied by the VOC conversion factor 1.0947 (EPA, 1992). The season daily emissions were calculated by multiplying FAEED output by the 24.6% summer seasonal percentage and dividing by 7 days a week and 13 weeks. Results are shown in Table 4-5.

Table 4-5. Phoenix Sky Harbor Air Carrier Emissions from FAEED

Pollutant	lbs/yr	tons/yr	lbs/season day
VOC	624,750	312.4	1,671
NO_x	10,901,280	5,450.6	29,149
CO	3,016,396	1,508.2	8,066

For other airports with air carrier operations, an average emission factor was calculated for each pollutant based on the Phoenix Sky Harbor total air carrier emissions and dividing by LTO cycles.

VOC = 785,849 lbs / 219,981 LTO = 3.57 lbs/LTO
NO_x = 13,712,302 lbs / 219,981 LTO = 62.33 lbs/LTO
CO = 3,794,209 lbs / 219,981 LTO = 17.25 lbs/LTO

4.2.3.2 Phoenix Sky Harbor Air Taxi

Air taxi emission factors were calculated from FAEED by averaging all long- and medium-range jets in the database and then dividing by the number of unique engines. Emission factors are shown in Table 4-2. Emissions for all airports except Phoenix Sky Harbor were calculated by multiplying air taxi LTO cycles by the emission factors. As discussed above, Sky Harbor taxi and carrier operations were reported together. Therefore of the total air carrier emissions calculated by FAEED for each pollutant, 20.5% were air taxi emissions. HC emissions were multiplied by the VOC conversion factor 1.0947 (EPA, 1992). The season daily emissions were calculated by multiplying the annual emissions by the 24.6% summer seasonal percentage and dividing by 7 days a week and 13 weeks per season. Results are shown in Table 4-6.

Table 4-6. Phoenix Sky Harbor Air Taxi Emissions from FAEED

Pollutant	lbs/yr	tons/yr	lbs/season day
VOC	161,099	80.5	431
NO_x	2,811,040	1,405.5	7,516
CO	777,813	388.9	2,080

Emissions for General Aviation included helicopters, and used the emission factors derived from FAEED. Military emissions were calculated using the FAEED emission factor for general military and the reported LTOs.

4.3 Procedure for Estimating Emissions from Locomotives

Chapter 6 of EPA's Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources (EPA, 1992), was followed when estimating locomotive emissions. Railroad operations are separated into three categories: 1) Class I line haul; 2) Class II and Class III line haul; and 3) yard operations. No Class II or Class III line haul (locally operated railroads), were operated within the nonattainment boundaries of Maricopa County in 1999. CO, NO_x, HC, and VOC emissions were calculated from Class I line haul and yard operations data and EPA emission factors (EPA, 1992, Tables 6-1 and 6-2). Total locomotive emissions in the inventory area were calculated by summing the emissions for both categories.

Railroads operating within the nonattainment boundaries of the Maricopa County are:

1. Union Pacific / Southern Pacific Railroad Company (UP)
   Ms. Deb Schafer (402) 271-2358
   1416 Dodge Street, Room 930
   Omaha, NE 68179

2. Burlington Northern & Santa Fe Railway Company (BNSF)
   Mr. John Chavez (909) 386-4082
   740 E. Carnegie Drive
   San Bernadino, CA 92408-3571

4.3.1 Line Haul Locomotives

Class I line haul locomotives carry mainly interstate freight and most of the passenger service. Emissions were calculated by multiplying the amount of fuel consumed by these locomotives in the inventory area by the appropriate emission factors (EPA, 1992, Table 6-1). UP provided 1999 Gross Tons (GT) and a Fuel Consumption Index (FCI) for all trains scheduled to operate in the nonattainment area of Maricopa County (Appendix 4-3). The following calculations show how the line haul locomotive emissions were obtained.

BNSF provided a Fuel Consumption Index (FCI) of 734 GTM/gal. (GTM = Gross Ton Miles)

1999 Gallons of Diesel per Line Segment =[GT × Length of segment (miles)] / FCI

$$= \frac{37{,}570{,}000 \text{ GT} \times 49.0 \text{ miles}}{734 \text{ GTM/gallon}} = 2{,}508{,}079 \text{ gallons diesel/yr}$$

1999 BNSF line haul locomotive emissions are:

Emissions lbs/yr = (annual fuel consumption) × (emission factor)

NO_x lbs/yr = (2,508,079 gal) × (0.4931 lbs/gal)
= 1,236,734 lbs/yr
= 618.4 tons/yr

CO lbs/yr = (2,508,079 gal) × (0.0626 lbs/gal)
= 157,006 lbs/yr
= 78.5 tons/yr

THC lbs/yr = (2,508,079 gal) × (0.0211 lbs/gal)
= 52,920 lbs/yr
= 26.5 tons/yr

VOC Profile Speciation for Diesel Engines: (Radian Corp.)
VOC = [1 – (0.1160 methane + 0.0280 ethane)] × (Total hydrocarbons, THC)
VOC = (1 – 0.1440) × (THC)
VOC = 0.856 × THC

VOC lbs/year = 0.856 × lbs HC
= 0.856 × 52,920 lbs
= 45,300 lbs/yr
= 22.6 tons/yr

The Union Pacific Railway Company (UP) determined fuel consumption and calculated emissions following the same method as described above. Traffic density data and fuel consumption index were provided by UP (Appendix 4-4). The 1999 fuel consumption as reported by UP for line haul locomotives in Maricopa County is calculated as follows:

1999 Gallons of Diesel per Line Segment: $= \frac{68{,}380{,}000 \text{ GT} \times 413 \text{ miles}}{722 \text{ GTM/gallon}} = 39{,}114{,}875$ gallons diesel/yr

1999 UP line haul locomotive emissions are:
NO_x lbs/yr = (39,114,875 gal) × (0.4931 lbs/gal)
= 19,287,555 lbs/yr
= 9,643.8 tons/yr

CO lbs/yr = (39,114,875 gal) × (0.0626 lbs/gal)
= 2,448,591 lbs/yr
= 1,224.3 tons/yr

THC lbs/yr = (39,114,875 gal) × (0.0211 lbs/gal)
= 825,324 lbs/yr
= 412.7 tons/yr

VOC lbs/yr = 0.856 × lbs HC
= 0.856 × 825,324 lbs
= 706,477 lbs/yr
= 353.2 tons/yr

Season day emissions were obtained by dividing annual totals by 365. Table 4-7 shows the line haul locomotive estimates by company for both the year and season day in 1999.

Table 4-7. Summary of Annual 1999 Emissions from Class 1 Line Haul Locomotives

Company	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
Union Pacific/ Southern Pacific Railroad	353.2	1,936	9,643.8	52,843	1,224.3	6,709
Burlington Northern & Santa Fe Railway	22.6	124	618.4	3,388	78.5	430
Totals:	375.8	2,060	10,262.2	56,231	1,302.8	7,139

4.3.2 Yard Locomotives

Emission calculations for yard locomotives are based on the number of yard/switch locomotives in operation during 1999. Yard/switch locomotives are primarily responsible for moving railcars within a particular railway yard. The national average of annual emissions per yard locomotive is multiplied by the total number of yard locomotives in operation to calculate emissions in tons per year. These emission factors were acquired from Table 6-2 of EPA's Procedures for Emission Inventory Preparation Vol. IV Mobile Sources (EPA, 1992). UP verified that four yard locomotives operated in 1999. BNSF verified that twelve yard locomotives operated in 1999. Therefore, the total number of yard locomotives in Maricopa County is sixteen. Emission calculations for these sixteen yard locomotives are shown below.

Emissions (lb/year) = (number of yard/switch locomotives) × (emission factor, lbs/yard locomotive)

VOC emissions = 16 × 4,174 × 0.856 = 57,167 lbs/yr = 28.6 tons/yr
NO_x emissions = 16 × 41,608 = 665,728 lbs/yr = 332.9 tons/yr
CO emissions = 16 × 7,375 = 118,000 lbs/yr = 59.0 tons/yr

Season day emissions were obtained by dividing the annual total by 365.

4.3.3 Summary of Locomotive Emissions

Total annual and season daily emissions from locomotives in the Maricopa County nonattainment area are shown in Table 4-8.

Table 4-8. Summary of 1999 Average Daily Ozone Season Emissions from Locomotives

Locomotive Type	VOC tons/yr	VOC lbs/day	NO_x tons/yr	NO_x lbs/day	CO tons/yr	CO lbs/day
Line haul, Class I	375.8	2,060	10,262.2	56,231	1,302.8	7,139
Line haul, Classes II and III	0.0	0	0.0	0	0.0	0
Yard operations	28.6	157	332.9	1,824	59.0	323
Totals:	**404.4**	**2,217**	**10,595.1**	**58,055**	**1,361.8**	**7,462**

4.4 Gasoline and Diesel Nonroad Equipment

Energy and Environmental Analysis, Inc. (EEA) prepared emission estimates for nonroad diesel equipment, 4-stroke gasoline equipment, and 2-stroke gasoline equipment sources (EEA, 1992) for EPA's Office of Mobile Sources (OMS). This "Inventory A" of nonroad equipment was compiled from commercially available marketing research data and publicly available indices of economic activity. Methods used to calculate these emission estimates are described in the Nonroad Engine and Vehicle Emission Study or NEVES (EPA, 1991). The inventories specific to Maricopa County were developed by EEA as part of the NEVES study. Excerpts were taken from the Nonroad Engine Emission Inventories for the CO and Ozone Nonattainment Boundaries, Phoenix Area (EEA, 1992) and include season day adjustments in addition to emissions for each individual engine type and category.

Maricopa County Environmental Services Department has taken these emission estimates and made the following modifications:

1. subtracted emissions applied to the nonattainment area from sources that do not operate in Maricopa County (snowmobiles and snowblowers);
2. developed an average nonroad engine inventory;
3. adjusted the engine type split for 2-stroke vs. 4-stroke lawn mowers;
4. adjusted NO_x emissions for construction equipment;
5. adjusted VOC emissions for lawn and garden equipment; and
6. adjusted the seasonal activity for all nonroad equipment.

In the NEVES study, two nonroad equipment inventories ("Inventory A" and "Inventory B") were created for serious ozone non-attainment areas. EPA guidance suggested that for planning purposes, the two inventories should be averaged. At the time of the study, Maricopa County was classified as moderate so the EEA study only provided an Inventory A, an inventory created from commercially and publicly available data.

During 1996, the Arizona Department of Environmental Quality contracted a study called the Voluntary Early Ozone Plan or VEOP (ADEQ, 1996). An improvement from the VEOP to the nonroad estimates was to create the "pseudo Inventory B" for the Phoenix area. Therefore, a pseudo Inventory B was developed by taking the EEA Inventory A for Phoenix and multiplying the emissions by the average ratio of Inventory B:Inventory A for three areas: El Paso, San Diego, and the San Joaquin Valley (Appendix 4-5). (Inventory B was created using industry provided data that is not publicly available.) Then the emissions from Inventory A and Inventory B were averaged to yield a new 1990 base year inventory. The following calculations show how the new 1990 base year inventory was developed.

1990 NEVES Pseudo Inventory B = 1990 NEVES Base × Average Ratio B/A

1990 New Base = (1990 NEVES Pseudo Inventory B + 1990 NEVES Inventory A) / 2

The 1996 emissions were calculated by multiplying this average of the two inventories, that represents the new 1990 base year emissions, by factors based on economic growth rates. The 1999 annual and average season day emissions listed in Appendix 4-6 for each source category were then calculated by multiplying the 1996 calculated emissions with appropriate growth factors for the period 1996–1999. These growth factors came from the Economic Growth Analysis System (EGAS), which was developed for the Reasonable Further Progress (RFP) inventory. EGAS, an EPA economic and activity forecast model, provides credible growth factors for developing projected emission inventories. Arizona agricultural statistics were used to develop factors for agricultural equipment. See Appendix 4-7 for growth factors used listed by engine type. The following general equation was used to calculate 1999 emissions:

1999 Emissions = 1996 Emissions × EGAS Growth Factor

For some of the nonroad equipment, further adjustments to the emission estimates were applied based on control measures. For lawn mowing equipment, the growth factor was reduced by 2.4% due to the Phoenix xeriscape ordinance. Oxygenated fuel effects were quantified for gasoline-powered equipment. This was a committed measure of the MAG 1999 Serious Area CO Plan, "Winter Fuel Reformulated Gasoline with 3.5 Percent Oxygen Content November 1 through March 31" (MAG, 1999). MAG ran EPA's CO COMPLEX model, and ascertained a 4.14% reduction in CO emissions from the nonroad gasoline-powered equipment, which was applied to the emissions.

Reductions to nonroad emissions based on new diesel engine standards were considered, however these new standards did not affect CO emissions in 1999 (EPA, 1998). The benefit assessment for the non-handheld nonroad engine rule stated that the rule had minimal effect on the CO inventory in nonattainment areas (EPA, 1996). Therefore, no effects were quantified in the 1999 CO emissions inventory for these two rules.

Two other adjustments were made from the REOP, the Reanalysis of the Metropolitan Phoenix Voluntary Early Ozone Plan prepared in October 1997 (ADEQ, 1997). One was a 52% reduction of NO_x emissions for construction equipment as the original 1996 base-case inventory had overestimated the NO_x emissions. The second was a 50% increase in VOC emissions for lawn and garden equipment as activities such as running and resting losses were not incorporated in the original inventory (ADEQ, 1997).

Another adjustment occurred with the 1996 emissions inventory. With respect to lawn mowers, local data collected by ADEQ for use in the REOP showed that the 5% to 95% split between 2-stroke and 4-stroke engines based on the VEOP that was used in the 1996 emissions inventory was inaccurate. In Maricopa County, surveyed residents indicated the split is 15% 2-stroke to 85% 4-stroke (ADEQ, 1997). The 1996 emissions were adjusted to reflect this new split, as the 1996 emissions estimates were the basis for the 1999 emissions.

Seasonal data from NEVES were replaced for all nonroad equipment categories. For agricultural equipment, seasonal percentages were determined using local statistics on crop acreage and tractor activity (Appendix 4-8). The crop acres were obtained from the 1999 Arizona Agricultural Statistics (AASS, 2000). Data on tractor activity for various crops were taken from both the 1993–1994 Arizona Vegetable Crop Budgets (U of A, 1993) and the 1994–1995 Arizona Field Crop Budgets (U of A, 1994) since more recent budgets did not contain the same detailed information. Taking the harvested acres of the principal crops grown in Maricopa County, a weighted seasonal activity average was calculated using monthly tractor activity per acre. This calculation included 222,402 acres of principal crops for which the following equation was used:

$$\text{Summer } \% = \frac{\sum\left[\text{crop acreage} \times \left(\frac{\text{no. tractor passes per acre in summer season}}{\text{no. of tractor passes per acre per year}}\right)\right]}{\text{total crop acreage}}$$

$$\text{Summer } \% = \frac{\begin{array}{l}[(83{,}700 \times 1/28) + (14{,}100 \times 0/9) + (23{,}400 \times 0/9) + (69{,}900 \times 3/32) + (702 \times 28/39) + (4{,}400 \times 15/28) \\ + (300 \times 33/37) + (2{,}700 \times 0/23) + (10{,}200 \times 15/103) + (3{,}600 \times 4/30) + (7{,}500 \times 0/35)] \times 100\%\end{array}}{222{,}402 \text{ acres}}$$

Summer % = 7.3%

For all nonroad equipment other than agricultural equipment, seasonal percentages were taken from monthly activity fractions listed in the California Air Resources Board (CARB) Documentation of Input Factors for the New Off-road Mobile Source Emissions Inventory Model (EEA, 1992). The activity levels are provided in Appendix 4-9. MCESD chose to use these seasonal percentages because they more closely resemble the limited data available for Maricopa County. For example, the CARB seasonal percentage of lawn and garden equipment activity for the winter season is 19.1%. In comparison, the NEVES study indicates that only 6% of the lawn and garden activity occur in the winter based on an analysis of agricultural activity from different climate areas of the country. This changes the ozone season day emissions, since the summer percentage according to CARB is 28.5%. This seasonal adjustment was applied to all engines in the NEVES lawn and garden category. The emission estimates for nonroad equipment are listed in Table 4-9.

Table 4-9. Summary of All Nonroad Equipment Emissions

Equipment Type	VOC tons/yr	VOC tons/day	NO_x tons/yr	NO_x tons/day	CO tons/yr	CO tons/day
Diesel	2,460.6	4.40	15,927.6	42.91	7,891.7	21.13
4-Stroke Gasoline	9,493.0	28.63	288.2	0.82	124,636.8	368.62
2-Stroke Gasoline	9,066.0	27.90	212.3	0.58	15,485.0	47.16
Totals:	21,019.6	60.93	16,428.1	44.21	148,013.5	436.91

4.5 Summary of All Nonroad Mobile Source Emissions

Table 4-10 provides a summary of all nonroad mobile source emissions.

Table 4-10. Summary of All Nonroad Mobile Source Emissions

Equipment Type	VOC tons/yr	VOC tons/day	NO_x tons/yr	NO_x tons/day	CO tons/yr	CO tons/day
Aircraft Activity	3,621.6	8.75	9,831.2	25.61	17,786.5	43.96
Locomotives	404.4	1.11	10,595.1	29.03	1,361.8	3.73
Nonroad Equipment	21,019.6	60.93	16,428.1	44.21	148,013.5	436.91
Nonroad Source Totals:	**24,045.6**	**70.79**	**36,854.4**	**98.85**	**167,161.8**	**484.60**

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SECTION 5. ONROAD MOBILE SOURCES

5.1 Introduction and Scope

Onroad mobile source emission estimates have been calculated for ozone (O_3) precursors for the 1999 Periodic O_3 Inventory. These onroad mobile source estimates are for the 1,872 square-mile O_3 nonattainment area within Maricopa County (see Figure I). Emission estimates were calculated for the following vehicle types: light duty gas vehicles (LDGV), light duty gas trucks of gross vehicle weight under 6000 pounds (LDGT1) or over 6000 pounds (LDGT2), heavy duty gas vehicles (HDGV), light duty diesel vehicles and trucks (LDDV and LDDT), heavy duty diesel vehicles (HDDV), and motorcycles (MC). Emission factors for these vehicle types were calculated using MOBILE5a. MOBILE5a is one of the MOBILE5 series of emission models, created by the U.S. Environmental Protection Agency (EPA) for the purpose of estimating motor vehicle emission factors. The MOBILE5a and MOBILE5b models are both acceptable to EPA for the modeling of onroad emissions at this time. The resulting emission factors were multiplied by estimates of vehicle miles of travel (VMT) to generate emission estimates.

The main reference sources for preparing the onroad mobile source portion of the inventory were as follows:

- Emission Inventory Requirements for Ozone State Implementation Plans, EPA-450/4-91-010, March 1991, (hereinafter referred to as EPA Guidance), and
- User's Guide to MOBILE5 (Mobile Source Emission Factor Model), EPA-AA-AQAB-94-01, May 1994, (hereinafter referred to as User's Guide), and
- Procedures for Emission Inventory Preparation Volume IV: Mobile Sources, EPA-450/4-81/026d (Revised), 1992.

5.2 VMT Estimation Procedure

MAG prepared the 1999 vehicle miles of travel (VMT) estimates for the ozone nonattainment area. The source of data for these estimates is the revised 1999 Highway Performance Monitoring System (HPMS) data (see Appendix 5.9.1) submitted to the U.S. Department of Transportation, Federal Highway Administration (FHWA) by the Arizona Department of Transportation (ADOT) in April 2001. ADOT initially submitted 1999 HPMS data to FHWA in August 2000. A revised version used in this analysis, incorporating improved traffic counts on the state highway system, was submitted in April 2001. The contact person for the VMT estimates is Cathy Arthur (602-254-6300).

Each year, MAG coordinates the collection of HPMS data, including the annual average daily traffic (AADT) estimates for HPMS sample sections which are utilized to develop HPMS VMT estimates. ADOT provides the AADT for the state highway system routes including interstates, urban freeways, and principal arterials in Maricopa County. ADOT merges the Maricopa County data with information from other Arizona counties to create the statewide HPMS dataset submitted to FHWA each year.

Arizona's HPMS database file contains a number of data elements that describe general roadway characteristics and use for every non-local roadway within the state. All non-local roadways were divided into section records that are 0.3 to 10 miles in length, in accordance with HPMS criteria. Such roadway segments are called HPMS "universe" section records. HPMS contains additional data elements that provide more detailed

operational and performance information on a randomly-selected subset of the file's 10,000+ universe records. These more detailed records containing additional highway attributes are known as "sample panels" or "sample sections." The VMT estimates which ADOT submits to FHWA each year are generated from HPMS universe data for all interstates, urban freeways, and principal arterials. Sample section data are expanded to estimate VMT on all other non-local systems.

VMT on local streets in the urbanized portion of the modeling area was estimated using traffic counts collected on 50 randomly-selected local streets in June-July of 1994. These counts resulted in an AADT of 587 for local roads in the urbanized area. To calculate VMT, this AADT was applied to local road mileage in 1994, obtained from the Maricopa County street centerline coverage. In 1994, an AADT of 150 was assumed for local roads which are inside the PM-10 (particulates of size ten microns or less) nonattainment area, but outside the urbanized area boundary. Since 1994, the AADTs on local streets have been increased annually on the basis of the rate of population growth in Maricopa County; the number of center line miles of local streets is updated annually by the local jurisdictions in Maricopa County. VMT for the ozone nonattainment area, based on the revised 1999 HPMS data ADOT submitted to FHWA in April 2001, is summarized by area type and facility type in Table 5-1. Area types are a function of population and employment density as described in Table 5-1. Facility types represent the characterizations of different roadway types such as capacity, design, and purpose (i.e. serving regional or neighborhood traffic).

The revised 1999 HPMS System Length and Daily Vehicle Travel for Individual Urbanized Areas (in Appendix 5.9.1) was submitted to FHWA by ADOT in April 2001. This table reported a 1999 average daily VMT for the Phoenix urbanized area of 55.072 million. In comparison, the 1999 urbanized area VMT for the ozone nonattainment area used in the periodic emissions inventory is 54.521 million. The one percent difference between these estimates is attributable to small sections of the Phoenix urbanized area (i.e. Apache Junction) which are not located in the ozone nonattainment area. The HPMS System Length and Daily Travel, Donut Area Data for Individual NAAQS Nonattainment Areas, (in Appendix 5.9.1), reported a revised 1999 VMT for the "donut" area of 5.174 million. The "donut" area is an HPMS term referring to the area inside the PM-10 nonattainment area, but outside the Phoenix urbanized area boundary. The VMT for the ozone nonattainment area is 72 percent of the HPMS "donut" area VMT or 3.725 million. The factors (i.e. 99 percent for the urbanized area and 72 percent for the donut area) used to determine the allocation of HPMS VMT to the ozone nonattainment area were derived from the report, Maricopa Association of Governments Highway Performance Monitoring System Update, January 1995. These same factors were also used to derive VMT for the CO tracking area in Chapter Three of the MAG 1999 Serious Area Carbon Monoxide Plan for the Maricopa County Nonattainment Area, June 1999. It is important to note that the 1999 HPMS daily VMT for the CO/Ozone nonattainment area is within one percent of the 1999 VMT estimated by the MAG travel demand models for the Serious Area CO Plan. The total 1999 daily VMT for the urbanized and "donut" areas in the CO/Ozone nonattainment area is 58.247 million, as shown in Table 5-1.

The VMT by facility type in Table 5-1 was derived from the 1999 HPMS data, while the distribution by area type was derived from 1998 traffic counts. These counts were assigned to a 1998 highway network using MAG travel demand models. The output of this assignment was evaluated using Geographic Information Systems (GIS) to obtain VMT by area type and facility type for the Phoenix urbanized and "donut" areas. The area type distributions from the MAG traffic assignment were applied to the 1999 HPMS VMT estimates by facility type for the urbanized and "donut" areas to create Table 5-1.

Although HPMS includes vehicle mix data for urban and rural areas of Arizona, there are insufficient classification stations in the Phoenix urbanized area to justify use of this information in calculating VMT by vehicle

class. In addition, the HPMS vehicle class data do not discriminate between gas and diesel vehicles. Therefore, MOBILE5a model defaults, representing the fraction of total VMT for each vehicle class, were applied to VMT estimates for each facility type and area type in Table 5-1.

Table 5-1. 1999 HPMS VMT by Area and Facility Type for the CO/Ozone Nonattainment Area (Annual Average Daily Traffic)

	AREA TYPE *					
Facility Type	**1**	**2**	**3**	**4**	**5**	**Total**
Interstate / Freeway	1,277,694	8,275,357	5,740,120	2,197,672	686,975	18,177,818
Principal Arterial / Minor Arterial	509,464	9,637,550	10,924,791	5,331,263	2,272,805	28,675,873
Collector **	261,621	2,943,882	1,374,465	652,983	823,809	6,056,760
Local	59,642	1,823,506	2,191,031	1,088,309	173,623	5,336,111
Total	2,108,421	22,680,295	20,230,407	9,270,227	3,957,212	58,246,562

* Area Type = f(DENSITY of a planning district) where:
DENSITY = (Population + 2 × Employment) / Area
For Area Type 1, DENSITY = 20,001+
For Area Type 2, DENSITY = 10,001–20,000
For Area Type 3, DENSITY = 5,001–10,000
For Area Type 4, DENSITY = 1001-5000
For Area Type 5, DENSITY = 0–1,000

** Collectors are minor streets that connect a neighborhood to a half-mile or mile arterial.

5.3 Speed Estimation Procedure

MAG prepared the average daily speeds for the 1999 periodic ozone emissions inventory. The average daily speeds were obtained from an EXPLORA emissions model run for 1999. EXPLORA was designed to integrate travel demand modeling output and FORTRAN-based emissions processing programs into a planning tool that may be applied at the subregional or regional level to examine transportation and related air quality issues.

The peak and off-peak speeds used in the EXPLORA volume to capacity (V/C) versus speed table were derived from the MAG study, 1993 Study of Travel Speed and Delay in the MAG Region, January 1995. The peak and off-peak speeds obtained from this study were coded into the link records for each road or street segment for which speed data were collected. A program called SPDVAL was then run to obtain the peak and off-peak speeds by area type and facility type. Freeways and arterials were the only two facility types with a sufficient sample size to obtain speeds by area type.

These peak and off-peak freeway and arterial speeds were used to revise the EXPLORA V/C versus speed table. Speeds for other minor facility types were derived from the MAG study, 1986 Phoenix Urbanized Area Travel Speed Study, October 1986. MAG plans to conduct a new speed study in FY 2002. It is anticipated that the results of this speed study will be incorporated into the next periodic inventory analysis.

1999 link-based traffic volumes and capacities output by the MAG travel demand model were input to EXPLORA to obtain average daily speeds by area type and facility type. The final speeds used in constructing the 1999 periodic emissions inventory are presented in Table 5-2.

Table 5-2. Average Daily Speeds for the 1999 Periodic Emissions Inventory

	Area Type *				
Facility Type	**1**	**2**	**3**	**4**	**5**
Interstate / Freeway	52.1	56.8	57.1	61.3	63.3
Principal Arterial / Minor Arterial	27.0	28.0	30.4	33.8	42.0
Collector	24.0	24.3	25.6	28.1	27.7
Local	15.0	20.0	25.0	25.0	30.0

* Area Type = f(DENSITY of a planning district) where:
DENSITY = (Population + 2 × Employment) / Area
For Area Type 1, DENSITY = 20,001+
For Area Type 2, DENSITY = 10,001–20,000
For Area Type 3, DENSITY = 5,001–10,000
For Area Type 4, DENSITY = 1001-5000
For Area Type 5, DENSITY = 0–1,000

5.4 Ozone Season VMT Factor

The Maricopa Association of Governments (MAG) developed the ozone season VMT factor for the ozone periodic emission inventory. Since the VMT utilized in the periodic emissions inventory is based on annual average daily traffic (AADT), it is necessary to examine the relationship between AADT and monthly traffic variations and correct for any differences.

The ozone season for the Maricopa County nonattainment area occurs from May through September. The peak ozone season reflects the three consecutive months when peak ozone concentrations occur, in accordance with the EPA Guidance. For consistency with the 1996 Base Year Ozone Inventory, the three consecutive months selected were July through September, 1999, in accordance with EPA guidance.

The ozone season VMT factor was developed from 1993 automated traffic recorder (ATR) data collected at five sites located in the ozone nonattainment area. Although there were eight active ATRs, only five collected twelve months of continuous data in 1993. The 1993 traffic count factors for the summer months for each ATR are provided below. These represent the ratio of the daily average counts by month to the daily average counts for the entire year.

	July	**August**	**September**
ATR 24 - Grand Ave @ Glendale Ave	0.95845	0.95537	0.98051
ATR 30 - Indian School @ 47th Dr	0.96516	0.98443	0.96176
ATR 31 - Central Ave @ Montebello	0.91834	0.94529	1.01136
ATR 32 - Lincoln Dr @ 23rd St	0.91253	0.91739	0.98011
ATR 34 - Squaw Peak Pkwy @ Crittendon	0.96093	0.97321	0.97972
Means:	0.94308	0.95514	0.98269

The average (arithmetic mean) of the monthly factors across all five stations is 0.96030. When this factor is applied, the resultant 1999 average daily VMT by area type and facility type for the ozone season is illustrated in Table 5-3.

Table 5-3. Average Daily VMT During 1999 Ozone Season (July-September)

	AREA TYPE *					
Facility Type	**1**	**2**	**3**	**4**	**5**	**Total**
Interstate / Freeway	1,226,970	7,946,825	5,512,237	2,110,424	659,702	17,456,159
Principal Arterial / Minor Arterial	489,238	9,254,939	10,491,077	5,119,612	2,182,575	27,537,441
Collector **	251,235	2,827,010	1,319,899	627,060	791,104	5,816,307
Local	57,274	1,751,113	2,104,047	1,045,103	166,730	5,124,307
Total	2,024,717	21,779,887	19,427,260	8,902,199	3,800,111	55,934,173

* Area Type = f(DENSITY of a planning district) where:
DENSITY = (Population + 2 × Employment) / Area
For Area Type 1, DENSITY = 20,001+
For Area Type 2, DENSITY = 10,001–20,000
For Area Type 3, DENSITY = 5,001–10,000
For Area Type 4, DENSITY = 1001-5000
For Area Type 5, DENSITY = 0–1,000

5.5 Emission Factor Estimation Procedure

5.5.1 Emission Factor Model

Volatile organic compounds (VOCs), oxides of nitrogen (NO_x) and carbon monoxide (CO) vehicle exhaust emission factors were calculated using MOBILE5a. MOBILE5a is one of the MOBILE5 series of emission models, created by the U.S. Environmental Protection Agency (EPA) for the purpose of estimating motor vehicle emission factors. The MOBILE5a and MOBILE5b models are both acceptable to EPA for the modeling of onroad emissions at this time. The resulting emission factors were combined with VMT estimates to produce emission estimates for ozone precursors. The MOBILE5a runs were executed by MAG. The contact person for the MOBILE5a emission estimates is Roger Roy (602-254-6300).

Three MOBILE5a runs were executed for ozone precursors for a typical day (24-hour period) during the three-month period of July through September:

1. Enhanced inspection/maintenance (I/M240) program in place with no exemption for current +4 model year vehicles. For the purposes of this analysis, the current +4 model years reflect the current model (2000) and the previous four model years (1996-1999).
2. I/M240 program with exemption for current +4 model year vehicles.
3. No I/M program in place.

The emission factors estimated with these runs were combined to reflect the actual proportions of vehicles subject to the specified levels of inspection. The term "I/M vehicles" denotes vehicles which are required to undergo an emission test and/or inspection under the Arizona Vehicle Inspection/Maintenance Program. It is important to note that participation in the I/M program is required for all vehicles *registered* in the nonattainment area, with the exception of certain model year and vehicle types. However, it is assumed that of the vehicles which are of an age and type subject to an I/M program, only 91.7 percent of the vehicles *operating* within the nonattainment area participate in the I/M program. The remaining 8.3 percent do not participate in the program. These percentages reflect the implementation of the control measures “Tougher Registration Enforcement” and “Expansion of Area A Boundaries”, described in the MAG 1999 Serious Area Carbon Monoxide Plan for the Maricopa County Nonattainment Area, MAG, June 1999. In the absence of any additional data, this percentage split is assumed to apply directly to VMT as well. Specifically, the base fraction of vehicles participating in the I/M

program in the Serious Area CO Plan (89.6 percent) has been increased by 2.0 percent, reflecting the full implementation of "Tougher Registration Enforcement" and by 0.1 percent, reflecting partial implementation of "Expansion of Area A".

In order to accurately reflect the state of the I/M program in the modeling area, several MOBILE5a runs were performed and factors from those runs were weighted together. As stated above, two MOBILE5a runs which reflected I/M and one which reflected no I/M were performed. The weighting of one I/M and one non-I/M run is explained in the previous paragraph. The weighting of *two* I/M runs is the result of a limitation to MOBILE5a. MOBILE5a does not accurately model a change in the variable "last model year tested", if the change in the "last model year tested" value occurred within the current I/M cycle.

This limitation is relevant because the current +4 model year vehicles were exempted from the I/M program beginning in August 1998. This modeling effort for the periodic ozone inventory reflects the three-month period, July 1999 through September 1999. In the middle of this three month period, i.e. August 1999, the current +4 exemption had been in effect for 12 months of the 24-month inspection cycle. For this reason, the change had effectively propagated through half (12 months/24 months) of the I/M240 fleet. The exemption of the recent model years was modeled through an equal weighting of two MOBILE5a runs, one reflecting the exemption of the current +4 model years (in this case, model years 1996-2000) and one which did not include that exemption.

Refer to Appendix 5.9.2 for portions of the actual input and output files and a spreadsheet showing the emission factor calculations.

5.5.2 Development of Model Inputs

The inputs to MOBILE5a are grouped into eight categories: Control Section, I/M Descriptive Input, Alternative I/M Credit Files, ATP Descriptive Input, Pressure Test Descriptive Input, Scenario Records, Local Area Parameter, and Oxygenated Fuels Descriptive Record. The input values used in the above described MOBILE5a runs are specified and explained below.

5.5.2.1 Control Section

1. TAMFLG=1 indicates that MOBILE5a default tampering rates were used as recommended in the User's Guide.
2. SPDFLG=1 indicates that user supplied speeds were applied to all vehicle types. Refer to item 3 in the Scenario Records section for development of input.
3. VMFLAG=1 indicates that MOBILE5a default VMT mix (national average) was used; this is due to the difficulty in obtaining accurate mileage accumulation rates by vehicle class. This parameter specifies the fraction of total VMT that is accumulated by each of the eight vehicle classes.
4. MYMFLG=3 indicates that user supplied registration distributions and MOBILE5a annual mileage accumulation rates were used, as recommended by the User's Guide. The vehicle registration distributions incorporated into this analysis are derived from registration data for 1999 provided by the Arizona Department of Transportation.
5. NEWFLG=1 indicates that MOBILE5a default basic exhaust rates were used as recommended by the User's Guide.
6. IMFLAG=1 and 3 means that separate MOBILE5a runs were executed; one, assuming no I/M program in place, and two others assuming that two I/M programs were in place. The emission factors obtained from

the two runs were then weighted assuming that 91.7 percent of the vehicles within the nonattainment area participated in the I/M program, and that 8.3 percent did not participate in the program.

7. ALHFLG=1 indicates that no additional correction factors were input. Correction factors were not required per the User's Guide.
8. ATPFLG=1 and 5 were input to indicate that one run involved no anti-tampering program and no pressure test and two runs included both an anti-tampering program and pressure test.
9. RLFLAG=5 indicates that refueling emissions were zeroed-out. Refueling emissions are calculated in the area source portion of the inventory.
10. LOCFLG=1 indicates that a separate Local Area Parameter (LAP) record was entered for each scenario of the MOBILE5a runs. The area type for which emission factors were being calculated was specified within each LAP record.
11. TEMFLG=1 indicates that MOBILE5a internally calculated the temperatures to be used in the correction of emission factors based upon the minimum and maximum daily temperatures provided in the LAP record. This option is recommended by the Users' Guide. Note: The ambient temperature input within each scenario record is overridden by the temperature internally calculated by the model.
12. OUTFMT=6 means outputs were in a spreadsheet format to facilitate subsequent calculations.
13. PRTFLG=4 indicates that calculations were performed on volatile organic compound (VOC), CO and NO_x emission factors.
14. IDLFLG=1 indicates that no idle emission factors were calculated. Idle emission factors are not necessary for this inventory.
15. NMHFLG=3 indicates VOCs (defined as non-methane hydrocarbons minus ethane corrected for aldehydes) were used in the calculation of HC emission factors as indicated in the EPA Guidance.
16. HCFLAG=1 indicates that only the sum of all VOC components (exhaust, evaporative, refueling, running loss, and resting loss VOC) was printed.

NOTE: The RLFLAG was set to five to zero out refueling emissions. Therefore, refueling emissions have not been included in the sum even though they are contained in the definition of all VOC components.

5.5.2.2 I/M Descriptive Input Record

The I/M240 inputs used for the 1999 periodic inventory are consistent with those used for the base case Serious Area CO SIP inventory for 2000 with minor adjustments made to the waiver rates and last model year tested.

1. PROGRAM START YEAR=77
2. STRINGENCY LEVEL=28% indicates that 28 percent of pre-1981 model year passenger cars or pre-1984 light duty trucks are expected to fail the initial I/M test in a given testing cycle.
3. FIRST MODEL YEAR=67 or 81 for the basic I/M or I/M240 program.
4. LAST MODEL YEAR=20 or 95
5. WAIVER RATE for PRE-1981 MODEL YEAR VEHICLES=1% indicates that one percent of pre-1981 model year vehicles which fail the initial I/M test will receive a waiver.
6. WAIVER RATE for 1981 and LATER MODEL YEAR VEHICLES=2% indicates that two percent of 1981 and later model year vehicles which fail the initial I/M test will receive a waiver.
7. COMPLIANCE RATE=97% indicates that 97 percent of the vehicles registered in the modeling area complete the I/M process to the point of either passing the I/M test or receiving a valid waiver.
8. PROGRAM TYPE=1 for centralized program.
9. INSPECTION FREQUENCY=1 or 2 for annual inspection frequency for the basic I/M or biennial frequency for the I/M240 program.

10. VEHICLE TYPES SUBJECT TO INSPECTIONS= 2222 or 2221 indicates that LDGV, LDGT1, LDGT2 and HDGV are all subject to inspection for the basic I/M program but that HDGVs are exempt from the I/M240 program.
11. TEST TYPE=3 or 4 for a loaded idle basic I/M test or a transient I/M240 test.
12. CUTPOINTS=1 or 2 indicates that MOBILE5a default cutpoints were used for the basic I/M program but that non-default cutpoints were used for the I/M240 test.
13. ALTERNATE I/M CREDITS INPUT BY USER=11 or 22 indicates that MOBILE5a default credits were used for Tech I-II and Tech IV+ vehicles for the basic I/M program but that alternate I/M credits were used for the I/M240 program.
14. USER SUPPLIED CUTPOINTS=2.00 30.0 3.00 indicates the cutpoints in grams per mile chosen for HC, CO, and NOx respectively. These cutpoints are used only for the enhanced I/M240 program.

5.5.2.3 Alternative I/M Credit Files

Since the I/M240 cutpoints in use in the nonattainment area are not a standard set of cutpoints built into the MOBILE5a program, an alternative set of cutpoints was developed by Radian International for use in onroad modeling. These alternative cutpoint credit files were further adjusted by MAG using the EPA Remote Sensing Utility to account for the implementation of the remote sensing program. The remote sensing program was repealed by the Arizona Legislature in 2000, but was still in place during the period modeled for the 1999 periodic ozone emissions inventory. A remote sensing program is a form of vehicle emissions inspection which measures instantaneous vehicle emissions during actual driving conditions. The credit files listed below are in ASCII format and contain a very large array of numbers used to apply emissions reductions credits.

1. TECH I-II VEHICLES CREDIT FILE= tech12.1me
2. TECH IV+ VEHICLES CREDIT FILE= imdata.1me

5.5.2.4 ATP Descriptive Input Record

The anti-tampering program (ATP) inputs are consistent with those used for the base case Serious Area CO SIP inventory for 2000.

1. PROGRAM START YEAR=87 indicates that the ATP program began in 1987.
2. FIRST MODEL YEAR=75 indicates that the ATP program includes vehicles of model year 1975 and later.
3. LAST MODEL YEAR=80 indicates that vehicles of model year 1981+ are exempt from the ATP program because they are subject to the I/M240 program.
4. VEHICLE TYPES SUBJECT TO INSPECTIONS= 2222 indicates that LDGV, LDGT1, LDGT2, and HDGV are all subject to inspection.
5. PROGRAM TYPE=1 for centralized program.
6. INSPECTION FREQUENCY=1 for annual inspection frequency.
7. COMPLIANCE RATE=97%
8. INSPECTIONS PERFORMED=22111222 indicates that the following ATP inspections are performed: air pump system, catalyst, evaporative control system, PCV system, and gas cap tests; and that the EGR system, fuel inlet restrictor, and tailpipe lead deposit tests are not performed.

5.5.2.5 Pressure Test Descriptive Input Record

The pressure test inputs are consistent with those used for the base case Serious Area CO SIP inventory for 2000.

1. PROGRAM START YEAR=96 indicates that the pressure test began in 1996.
2. FIRST MODEL YEAR=81 indicates that the pressure test includes vehicles of model year 1981 and later.
3. LAST MODEL YEAR=20 or 95
4. VEHICLE TYPES SUBJECT TO INSPECTIONS= 2221 indicates that LDGV, LDGT1, and LDGT2 are all subject to inspection. HDGV are exempt from the pressure test.
5. PROGRAM TYPE=1 for centralized program.
6. INSPECTION FREQUENCY=2 for biennial inspection frequency.
7. COMPLIANCE RATE=97%

5.5.2.6 Scenario Records

1. REGION=1 indicates that the geographic area modeled was characterized as low altitude.
2. CALENDAR YEAR=99 indicates that 1999 was the year being modeled.
3. SPEED; a scenario utilizing the speed for each combination of facility and area type was executed (see Table 5-2). Speed values were input for interstates/freeways, principal arterials/minor arterials, collectors, and local roads. These speed values were derived from the 1993 Travel Speed Study.
4. AMBIENT TEMPERATURE=96 degrees Fahrenheit; the ambient temperature was calculated by MCESD (see Appendix 5.9.3) in accordance with the temperature guidance and input in each scenario. It is important to note that this temperature is not actually utilized by the model due to TEMFLG=1. *Refer to item 11 in the Control Section for additional information.*
5. OPERATING MODES=20.6, 27.3, 20.6; the MOBILE5a (FTP) standard operating mode fractions were used as recommended by the User's Guide. These values represent percent cold-start/non-catalyst VMT (PCCN), percent cold-start/catalyst VMT (PCCC), and percent hot-start/catalyst VMT (PCHC) respectively. The other relevant operating mode conditions of stabilized-start/catalyst VMT, stabilized-start/non-catalyst VMT, and hot-start/non-catalyst VMT are derived internally by MOBILE5a using PCCN, PCCC, PCHC.
6. MONTH OF EVALUATION=7 indicates that July was the month being evaluated.

5.5.2.7 Local Area Parameter Record

1. SCENARIO NAME; An area type and facility type were indicated for each scenario (speed).
2. ASTM VOLATILITY CLASS was left blank because the RFGFLG (Item 8 below) was set to indicate no reformulated gasoline. Rather, actual monitored fuel data for the modeling period was input to the model, as described in number eight.
3. MINIMUM and MAXIMUM DAILY TEMPERATURE=80 and 104 degrees Fahrenheit; for consistency, the same daily minimum and maximum temperatures used in preparing the 1990 Base Year Ozone Inventory were also used for the 1999 periodic inventory. The temperatures were calculated by the Maricopa County Environmental Services Department (MCESD) using EPA-recommended procedures (see Appendix 5.9.3).
4. "PERIOD 1" RVP=6.71; to determine these inputs, RVP data were obtained from the Arizona Department of Weights and Measures for the applicable period and averaged (see Appendix 5.9.4).
5. "PERIOD 2" RVP=6.71 and "PERIOD 2" START YEAR=2020; the RVP for period 2 is the same as for period 1, with a start year of 2020. The period 2 RVP is in effect being dummied out because only one calendar year is being modeled.

6. OXYFLG=2 indicates the effects of oxygenated fuels were modeled in order to represent actual conditions that existed in the applicable period.
7. DSFLAG=2 indicates that locally derived diesel sales fractions were used. The diesel sales fractions immediately follow the Oxygenated Fuels Descriptive Records.
8. RFGFLG was left blank, indicating that the reformulated gasoline flag was set to indicate no reformulated gasoline. Rather than permitting MOBILE5a to set the local gasoline RVP and oxygenate content to reflect default values for Federal RFG, measured gasoline RVP and oxygenate data, provided by the Arizona Department of Weights and Measures for the appropriate time period, were input to MOBILE5a.

5.5.2.8 Oxygenated Fuels Descriptive Record

1. MTBE BLEND MARKET SHARE= 100%; The MTBE market share fraction for the applicable period was obtained from the Arizona Department of Weights and Measures.
2. ALCOHOL BLEND MARKET SHARE=0%; The ethanol market share fraction for the applicable period was obtained from the Arizona Department of Weights and Measures.
3. AVERAGE OXYGEN CONTENT OF ETHER BLEND FUELS=1.7%; to determine this input, testing data were obtained from the Arizona Department of Weights and Measures for the applicable period (see Appendix 5.9.4).
4. AVERAGE OXYGEN CONTENT OF ALCOHOL BLEND FUELS=0.0%; to determine this input, testing data were obtained from the Arizona Department of Weights and Measures for the applicable period (see Appendix 5.9.4).
5. RVP WAIVER SWITCH=1 indicating a 1 psi exemption was not utilized. This is because actual RVP data was input to the model.

5.5.3 Model Outputs

MOBILE5a was executed with the inputs described above to obtain composite emission factors in grams per mile (g/mi) for exhaust VOC, NO_x, and CO. These values were obtained for the eight vehicle classes described in the Introduction for the various speeds as described in item 3 of the Scenario Records section. The emission factors generated for the 1999 ozone season are presented in the following section. Representative output runs are contained in Appendix 5.9.2. These values were then used in developing emission estimates.

5.5.4 Summary of Emission Factors

Refer to Appendix 5.9.2 for the emission factors developed for VOC, NO_x, and CO for each vehicle class, facility, and area type.

5.5.5 Emission Estimates

MOBILE5a was used to generate VOC, NO_x, and CO emission factors for vehicle class, facility, and area type. Daily VMT (DVMT) for the O_3 season (Table 5-3) was then multiplied by the VMT mix by vehicle class and the appropriate O_3 precursor emission factor (Appendix 5.9.2) to calculate O_3 precursor emission estimates on a kilogram per day (kg/day) basis. An example calculation is given below:

677,246	×	0.634	×	1.649 /	1,000	= 708
(DVMT)		(VMT Mix)		(VOC E.F. in g/mi)	(grams per kilogram)	(VOC emissions in kg/day)

708 VOC kg/day × 1 lb / 0.4536 kg = 1,560 VOC emissions in lbs/day

Tables 5-4A, 5-4B, and 5-4C show daily VMT data, associated speed estimates, MOBILE5a emission factors, and the calculated VOC, NO_x, and CO emissions for each vehicle class, facility, and area type.

5.6 Summary of Ozone Season Day Emissions from Onroad Mobile Sources

In the appendices, Tables 5-5A, 5-5B, and 5-5C summarize the calculated O_3 precursor emissions (categorized as VOC, NO_x, and CO, respectively) by vehicle class, area, and facility type. The total VOC, NO_x, and CO emissions from daily onroad mobile sources for the Maricopa County nonattainment area for the 1999 ozone season are estimated to be:

- 82,051 kg/day of VOC or 180,888 lbs/day of VOC
- 133,493 kg/day of NO_x or 294,295 lbs/day of NO_x
- 575,264 kg/day of CO or 1,268,218 lbs/day of CO

The Clean Air Act Amendments (CAAA) require that the ozone periodic inventory include an estimate of CO emissions. It is important to note that the above CO total is for the ozone season (July, August, and September). The CAAA also require a 1999 Periodic Inventory for CO. The estimate of CO season (November 1999 through February 2000) emissions from the onroad mobile portion of the 1999 CO Periodic Inventory is 490,261 kg/day or 1,080,822 lbs/day. The estimate of wintertime CO emissions is lower than the estimate of summertime CO emissions due to seasonal control measures for CO, such as the oxygenated fuels program, which is not in effect during the ozone season.

NOTE: Consistent with the 1990 base year inventory, only seasonal emissions were calculated for this portion of the inventory. In consultation with Mary Ann Warner-Selph, EPA Emissions Inventory Branch, it was determined that annual emission estimates were unnecessary for the 1990 base year inventory.

5.7 Quality Assurance Process

5.7.1 VMT Estimates

Normal quality assurance procedures, including extensive automated consistency checks, were used by ADOT in developing the 1999 HPMS data. These data were initially submitted to the Federal Highway Administration (FHWA) in August 2000. ADOT submitted an updated version of HPMS, incorporating improved 1999 traffic counts on the state highway system, to FHWA in April 2001. The contact person for the VMT estimates is Cathy Arthur (602-254-6300).

5.7.2 Emission Factor Estimates

The quality assurance (QA) process performed on the MOBILE5a analyses included accuracy, completeness, and reasonableness checks. For accuracy and completeness, a system was used that included a two-layer, independent reviewer set-up. All hard copy and computer-based data entries as well as all calculations procedures were checked independently for accuracy and completeness by two different reviewers. Any errors found were corrected and the changes were then rechecked by the reviewers.

The entire onroad mobile source portion of the 1999 periodic O_3 inventory was reviewed by MAG staff that did not directly participate in its development. All comments were addressed.

Quality Review of 1999 Draft Ozone Emission Inventory

The draft onroad mobile source portion of the 1999 periodic ozone inventory was reviewed using published EPA quality review guidelines for base year emission inventories (EPA Document 450/4-91-022, September 1991). The procedural review (Levels I, II, and III) included checks for completeness, consistency, and the correct use of appropriate procedures.

Additionally, the draft onroad mobile source portion of the 1999 periodic ozone inventory was compared with the onroad mobile source portions of the 1990, 1993, and 1996 base year and periodic inventories. The results are in the following tables.

Table 5-4. VOC Onroad Mobile Emissions Comparison from 1990 to 1999

Year of Analysis	Onroad Emissions (kg/season day)	Onroad Emissions (lbs/season day)	Vehicle Miles Traveled (VMT/season day)
1990	136,178	300,216	42,545,983
1993	108,494	239,184	46,555,338
1996	86,312	190,282	51,329,514
1999	82,051	180,888	55,934,173

Table 5-5. NO_x Onroad Mobile Emissions Comparison from 1990 to 1999

Year of Analysis	Onroad Emissions (kg/season day)	Onroad Emissions (lbs/season day)	Vehicle Miles Traveled (VMT/season day)
1990	129,839	286,241	42,545,983
1993	131,086	288,990	46,555,338
1996	129,589	285,690	51,329,514
1999	133,493	294,295	55,934,173

Table 5-6. CO Onroad Mobile Emissions Comparison from 1990 to 1999

Year of Analysis	Onroad Emissions (kg/season day)	Onroad Emissions (lbs/season day)	Vehicle Miles Traveled (VMT/season day)
1990	909,562	2,005,207	42,545,983
1993	775,056	1,708,677	46,555,338
1996	563,864	243,086	51,329,514
1999	575,264	1,268,218	55,934,173

While the VMT increases over time, the modeled onroad emissions continue to decrease or remain relatively constant, principally because of a vehicle fleet with cleaner engine and emission control technologies, augmented by local controls such as the I/M program and cleaner gasoline.

5.8 References for Section 5

U.S. Environmental Protection Agency. Emission Inventory Requirements for Ozone State Implementation Plans. EPA-450/4-91-010. March 1991.

Maricopa Association of Governments. MAG 1999 Serious Area Carbon Monoxide Plan for the Maricopa County Nonattainment Area. June 1999.

Lee Engineering, Inc., for MAG. Maricopa Association of Governments Highway Performance Monitoring System Update. January 1995.

Parsons Brinkerhoff Quade & Douglas, Inc., for MAG. 1986 Phoenix Urbanized Area Travel Speed Study, October 1986.

Lee Engineering, Inc., for MAG. 1993 Study of Travel Speed and Delay in the MAG Region. January 1995.

U.S. Environmental Protection Agency. Procedures for Emission Inventory Preparation Volume IV: Mobile Sources, EPA-450/4-81-026d (Revised), 1992.

U.S. Environmental Protection Agency. Quality Review Guidelines for 1990 Base Year Emission Inventories, EPA-454/R-92-007, July 1992.

U.S. Environmental Protection Agency. User's Guide to MOBILE5 (Mobile Source Emission Factor Model), EPA-AA-AQAB-94-01, May 1994.

SECTION 6. BIOGENIC SOURCES

6.1 Introduction and Scope

Biogenic source emission estimates have been calculated for ozone precursors for use in the 1999 Periodic Ozone Inventory. These biogenic source emission estimates are for the 1872 square-mile ozone nonattainment area within Maricopa County. These emissions were estimated using a modified version of the UAM-BEIS 2 model called MAGBEIS2. MAGBEIS2 was developed for use in Maricopa County and is documented in Improvements to the Biogenic Emission Estimation Process for Maricopa County, STI, 1996. MAGBEIS2 main modifications to UAM-BEIS2 was the addition of procedures that allow for the input of user-supplied gridded land use and surface temperature data. These procedures included the development of a land use preprocessor called MAGLAND2 to consolidate the MAG land use data to categories compatible with MAGBEIS2.

The guiding principle used in the development of MAGBEIS2 was the replacement of EPA defaults with locale-specific data, including: locale-specific land use data, locale-specific biomass estimates, and the use of a taxonomic approach to develop local-specific emission factors. By using the most recent biogenic emission model, UAM-BEIS 2, as a starting point in the development of MAGBEIS2, it was possible to incorporate updated science for estimating biogenic emissions. Overall, these changes constitute an improvement over the default procedures used by EPA, and is considered to provide better estimates of the biogenic emissions in the study area.

6.2 Modeling Domain Adjustments

The emissions reported in the periodic inventory are for the ozone nonattainment area. Due to the irregular shape of the ozone nonattainment area, it was not possible to use the ozone nonattainment area as the modeling domain. The modeling domain used to estimate biogenic emissions was the smallest rectangle that contained the entire nonattainment area. The modeling domain used in the present study is shown in Figure 6-1. The domain consists of 42 grid cells in the east-west direction and 39 grid cells in the north-south direction, with a uniform horizontal grid spacing of 2 kilometers. The domain is primarily located within Maricopa County, although a small fraction extends into Pinal County and Yavapai County.

The emissions estimated using the MAGBEIS2 model are for the rectangular modeling domain previously described. These estimates were adjusted to estimate the nonattainment area emissions through the use of an adjustment factor. The adjustment factor, 0.78, is the ratio of the area in the nonattainment area divided by the area in the modeling domain. The adjustment factor was multiplied by the estimated emissions in the modeling domain to yield an estimate of the emissions in the nonattainment area.

6.3 Land Use Categories

The most critical input for the biogenic emission modeling is the land use data file. The most recent land use information was incorporated in updating the periodic inventory. The most recent land use data compiled by MAG included 24 land use types using 1995 information. These 24 categories are listed in Table 6-1. Because the number of land use types for MAG 1995 land use data is different than the land use data used in the study by STI in 1996, a set of formulas as shown in Table 6-2 was developed for consolidating the 24 1995 land use types to eight land use groups used in the biogenic emissions model. Due to lack of information for the individual agricultural types in the MAG 1995 land use data there is only one category for agriculture.

Figure 6-1. Ozone and CO Nonattainment Area and Biogenic Modeling Domain

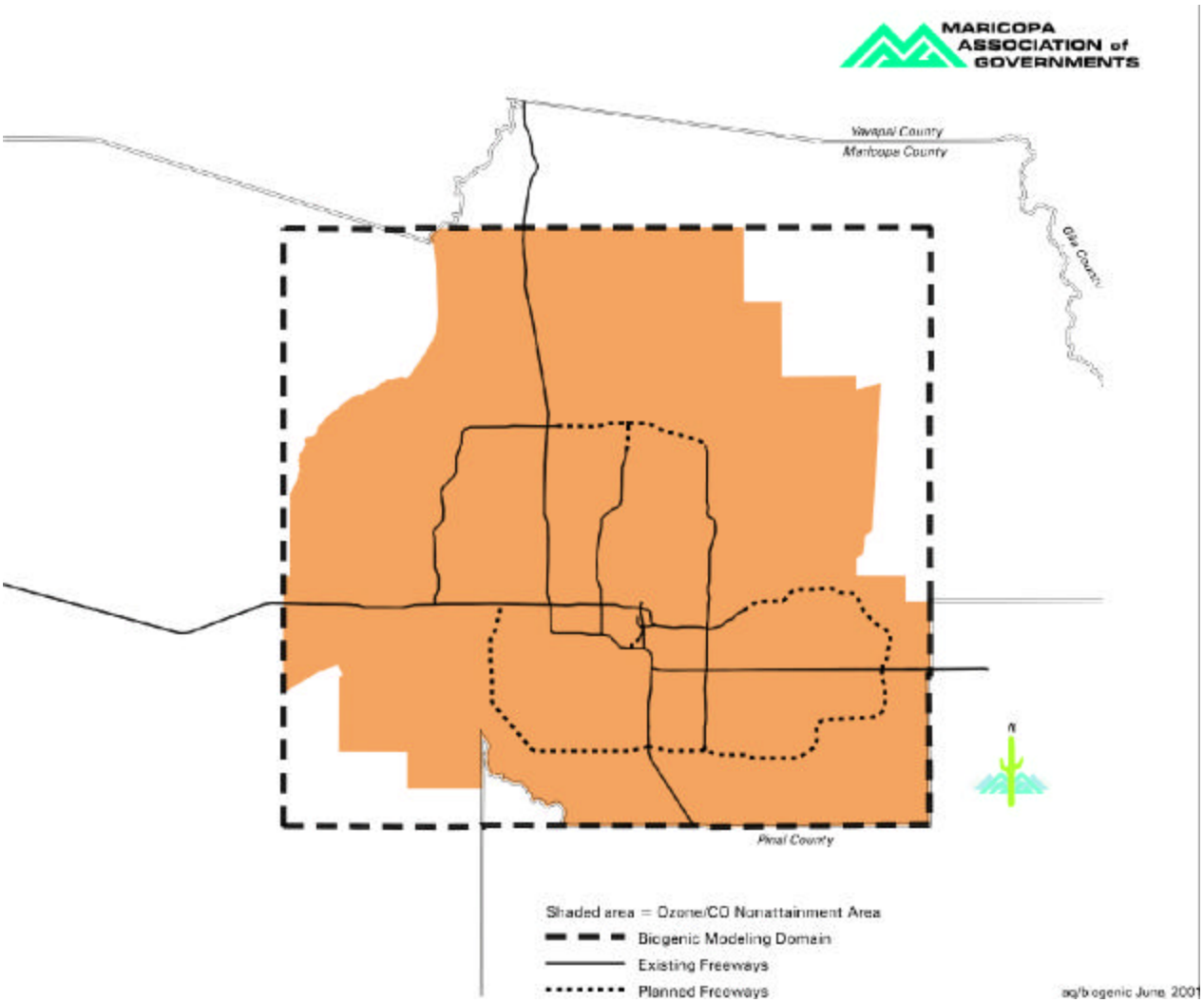

Table 6-1. MAG Land Use Categories Using 1995 Information

1. Rural	13. Office Buildings
2. Large Lot Residential	14. Education
3. Small Lot Residential	15. Institution
4. Medium Density Residential	16. Public Facilities
5. High Density Residential	17. Large Assembly Areas
6. Neighborhood Retail Centers	18. Transportation
7. Commercial Retail Centers	19. Airports
8. Regional Retail Centers	20. Recreation/Open Space
9. Hotel, Resort	21. Non-Developable Open Space
10. Warehouse District	22. Water
11. Industrial	23. Agriculture
12. Business Parks	24. Mixed Use

Table 6-2. Formulas to Consolidate the 24 Land Use Assignments (1995) into 8 Categories

1. Commercial/Industrial	= LU(6 to 13) + LU(15 to 19)
2. Residential/Schools/Churches	= LU(1 to 5) + LU(14)
3. Parks/Golf Courses	= ~LU(20)
4. Agricultural	= LU(23)
5. Desert	= LU(21) + LU(24)
6. Forests	= None
7. Water	= LU(22)
8. Desert Park	= cells with LU(20) and less than 15% residential area

where LU denotes the land use code assignments used as listed in Table 6-1 and ~LU(20) stands for the residual of LU(20) after subtracting the portion for the 8th category of "Desert Parks".

6.4 Derivation of Emission Factors

For each of the eight consolidated land use groups, MAGBEIS2 requires as input a standardized emission factor for isoprene, monoterpene, other volatile organic compounds (OVOCs), and oxides of nitrogen (NO_x). The emission factors selected for use in MAGBEIS2 are listed in Table 6-3. Most of the emission factors were identical to those used in the 1996 STI study, except for the "Agricultural" category. Detailed development of the emission rate estimate for the other land use types is discussed in Sonoma Technology Inc, 1996. The development of the emission rate estimate for the "Agricultural" category is provided below.

Arizona crop statistics for 1999 were obtained for Maricopa County by land use type as documented in 1999 Arizona Agricultural Statistics, Arizona Agricultural Statistics Service, 2000. These values are shown in Table 6-4. The non-citrus (other crops) acreage shown in this table were used to derive the percentages of these crop types relative to the total other crop land use area: Cotton - 37.17 percent, Alfalfa - 27.53 percent, Other Hay - 3.51 percent, Wheat - 6.26 percent, Barley - 9.95 percent, Corn - 0.44 percent, Potatoes - 3.33 percent, Other Vegetables - 10.92 percent, Grapes - 0.89 percent. These percentages, as fractions, were multiplied by the U.S. EPA reported standardized emission factors for isoprene, monoterpenes, OVOC, and NOx for each crop type to get a composite emission factor for "Other Crops". The emission factor for "Citrus" is the same as that reported by EPA for orange. EPA reported standardized emission factor for "Grass" is considered appropriate for the "Stockyards" category.

Since the 1995 MAG land use data only contain a single agriculture category, MAG calculated a composite emission factor based on the land distribution fractions for "Citrus", "Other Crops", and "Stockyards" from the 1990 land use data, as shown in Table 6-5. This approach relies on the assumption that the changes occurring in agriculture land use affect each agriculture subcategory equally. As a result, the emission factor for the new "Agricultural" category was computed by combining the three 1990 agriculture land use categories into a weighted-average emission factor for each VOC species (paraffin, olefins, aldehyde, and isoprene), OVOC, and NOx. The fraction of each 1990 agriculture subcategory was multiplied by its respective updated emission factor and the sum of these three products is the agriculture emission factor used for this periodic inventory.

Table 6-3. Landscaped Fraction (flscp) VOC and NO_x Standardized Emission Factors, by Land Use Category ($\mu g/m^2/hr$)

Land Use Category	Isoprene	Monoterpene	OVOC	NOx
Urban (Commercial/Industrial)	102 [e]	22 [e]	22 [a]	1.8 [b]
Residential/Schools/Churches	1224 [e]	263 [e]	263 [a]	22.1 [c]
Parks/Golf Courses	2830 [e]	415 [e]	415 [a]	57.8 [d]
Agricultural	21.2	54.7	49.4	137.4
Citrus Crops	42.5 [d]	680 [d]	693.7 [d]	4.5 [d]
Other Crops	18.4 [d,e]	17.3 [d,e]	13.2 [d,e]	147.7 [d,e]
Stockyards	56.2 [d]	140.5 [d]	84.3 [d]	57.8 [d]
Desert	110 [e]	55 [e]	33 [d]	57.8 [d]
Forests	110 [e]	55 [e]	33 [d]	57.8 [d]
Water	0 [d]	0 [d]	0 [d]	0 [d]
Desert Parks	110 [e]	55 [e]	33 [d]	57.8 [d]

a. OVOC emission rate set equal to monoterpene emissions rate.
b. U.S. EPA emission factor for grass multiplied by the landscape fraction.
c. U.S. EPA emission factor for commercial and industrial multiplied by the landscape fraction.
d. U.S. EPA-recommended values.
e. Based on locale-specific data.

Table 6-4. Maricopa County Crop Statistics for 1999 [a]

Crop	Acres	% of total
Cotton:		37.17
–Upland Cotton	83,700	
–Pima Cotton	0	
Alfalfa	62,000	27.53
Other Hay	7,900	3.51
Wheat:		6.26
–Durum Wheat	12,000	
–Other Wheat	2,100	
Barley	22,400	9.95
Corn For Grain	1,000	0.44
Potatoes	7,500	3.33
Other Vegetables	24,600	10.92
Grapes	2,000	0.89
Total	225,200	100.00
Citrus Crops:		
–Grapefruit	2,500	19.53
–Oranges	5,800	45.31
–Lemons	1,300	10.16
–Tangerines	3,200	25.00
Total	12,800	100.00

[a] All values were derived from 1999 Arizona Agricultural Statistics, Arizona Agricultural Statistics Service, 2000.

Table 6-5. Land Distribution of Citrus, Other Crops, and Stockyards (MAG 1990 land use data)

Category	Area (m^2)	Fraction (%)
Citrus	54,697,238	4.88
Other Crops	1,022,227,866	91.11
Stockyard	45,060,488	4.02
Total	1,121,985,592	100

6.5 Meteorological Inputs

Consistent with previous periodic inventories, 1990 Base Year Ozone Emission Inventory, Maricopa County Environmental Quality & Community Services Agency, 1993 and 1993 Periodic Ozone Emission Inventory, Maricopa County Environmental Services Department, 1996, the modeling day used was September 9, 1988. The procedures of selecting the modeling day was in accordance with the EPA guidance documented in the User's Guide to the Personal Computer Version of the Biogenic Emissions Inventory System (PC-BEIS), Version 2.0, EPA, 1991 and is illustrated in Appendix 6-1. Meteorological data are input to MAGBEIS2 from two separate files. The first file called "SURMET1" was created using observed data from the Sky Harbor Airport. The file includes the following meteorological fields:

- Opaque sky cover
- Total sky cover
- Fraction of sky occupied by the lowest level clouds and height of that cloud level
- Fraction of sky occupied by the second lowest level clouds and height of that cloud level
- Fraction of sky occupied by the third lowest level clouds and height of that cloud level

The above fields are used to determine the solar radiation fluxes in the current version of MAGBEIS2. The following fields in the data file are not used by the program but the format is reserved for the program to read successfully:

- Sea level pressure
- Wind direction
- Wind speed
- Surface temperature
- Dew point
- Station pressure

The second meteorological data file, "TEMPRTR", consists of 24 hours per day of gridded surface temperature fields created from a UAM preprocessor program. TEMPRTR is in binary format and can be used as an input to UAM. Data used to generate the surface temperature fields were obtained from ten monitoring sites for the modeling day. See Table 6-6 for more information about the ten monitoring sites for this analysis. The meteorological data files for running MAGBEIS2, including SURMET1 and surface temperatures, are provided in Appendix 6-2.

Table 6-6. Information for Surface Temperature Monitoring Sites

ID	Station	Latitude	Longitude	Network [a]
SKY	Sky Harbor Airport	33°26'03"	112°03'04"	NWS
SMPK	S. Mt. Park	33°20'46"	112°02'59"	FCDMC
GILA	Gila Bend Mt.	33°14'28"	113°12'14"	FCDMC
HORS	Housethief Basin	34°06'19"	112°20'49"	FCDMC
MTUN	Mt. Union	34°24'54"	112°24'17"	FCDMC
CARE	Carefree Ranch	33°52'03"	111°51'00"	FCDMC
WADD	Waddel	33°37'05"	112°27'35"	AZMET
GREE	Phx. Greenway	33°29'07"	112°06'30"	AZMET
ENCA	Phx. Encanto	33°28'45"	112°05'47"	AZMET
LITC	Litchfield	33°28'02"	112°23'53"	AZMET

[a] NWS: Nation Weather Service, MDMS on EPA NCC/IBM server
FCDMC: Flood Control Department Maricopa County, Julie Riemenschneider
AZMET: The Arizona Meteorological Network, http://ag.arizona.edu/azmet/

6.6 Summary of Emissions from Biogenic Sources

Total biogenic emissions for the Maricopa County 1999 periodic ozone emission inventory are summarized in Table 6-7 below.

Table 6-7. Summary of Biogenic Source Ozone Season Day Emissions

Pollutants	Metric Tons/Day
NO_x	10.03
Hydrocarbons:	48.67 [b]
–Paraffin	19.65
–Olefins	2.49
–Aldehyde	6.76
–Isoprene	19.77

[b] Note that the hydrocarbons total may not equal the sum of the hydrocarbon components due to rounding differences.

6.7 References for Section 6

Arizona Agricultural Statistics Service. 1999 Arizona Agricultural Statistics. July 2000.

Maricopa County Environmental Quality & Community Services Agency. 1990 Base Year Ozone Emission Inventory. final submittal. July 1993.

Maricopa County Environmental Services Department, 1993 Periodic Ozone Emission Inventory. November 1996.

Sonoma Technology, Inc. Improvements to the Biogenic Emission Estimation Process for Maricopa County. draft final report STI-95160-1577-DFR. May 1996.

U. S. Environmental Protection Agency. User's Guide to the Personal Computer Version of the Biogenic Emissions Inventory System (PC-BEIS), Version 2.0. EPA-450/4-91-017. July 1991.

U.S. Environmental Protection Agency. Urban Airshed Model (UAM) Biogenic Emission Inventory System Version 2 (BEIS-2) User's Guide. final report, EPA contract no. 68-D3-0034. September 30, 1997.

SECTION 7. QUALITY ASSURANCE

7.1 Introduction

This section describes the Quality Assurance (QA) procedures followed by the Maricopa County Environmental Services Department (MCESD) in the production of this 1999 Periodic Ozone Emissions Inventory for the Maricopa County nonattainment area. This section does not include the QA procedures taken when preparing the onroad mobile section of this inventory. QA for onroad mobile can be found in Section 5.5. The procedures followed when preparing stationary point, stationary area, and the aircraft and locomotive section of nonroad mobile included:

1. Reviewing the descriptive information contained in each section to assure completeness, clarity and correctness;
2. Examining formulas, calculations and conversions to assure autonomy from errors and inconsistencies;
3. Evaluating data quality to assure the value of the inventory, both as a representative data set of the state of the air environment in the Maricopa County nonattainment area and as the reference point for future inventories; and,
4. Assessing, where possible, the significance of the calculated quantities to assure reasonable accuracy and justifiable precision.

The QA section of the Maricopa County ozone emissions inventory follows the QA/QC plan section of the Inventory Preparation Plan for the 1999 Ozone Periodic Emission Inventory (MCESD, 2001). This should show, without ambiguity, that Maricopa County's QA plan was implemented.

7.2 Purpose of an Emissions Inventory

Several objectives motivated the development of the emissions inventory:

1. To comply with the inventory requirements of the Federal Clean Air Act Amendments of 1990 and specifications of the Environmental Protection Agency;
2. To provide a baseline against which to evaluate trends and successes in VOC emission reduction efforts;
3. To support development of air quality models and planning activities; and
4. To underscore particular concerns and to direct attention to areas where significant air quality improvement is achievable.

To assure production of an emissions inventory that is complete, accurate, and in compliance with requirements set forth in the EPA document Guidance for the Preparation of Quality Assurance Plans for Ozone / Carbon Monoxide SIP Emission Inventories, four operational steps were followed: (1) planning; (2) collecting data, distinguishing point sources from area sources and establishing data collection procedures appropriate for each type of source considered; (3) analyzing data and developing emission estimates for each type of source; and (4) summarizing and reporting data.

7.3 Quality Assurance Staff

The Quality Assurance program staff is comprised of:

Renee Kongshaug, MCESD	Internal QA Coordinator
Bob Downing, MCESD	Point sources
Ruey-in Chiou, MAG	Highway vehicle emissions
Randy Sedlacek, ADEQ	Oversight and external QA

7.4 Implementation

Quality assurance checks occurred on receipt of data (missing and/or questionable data), on completion of calculations (computational methods, accuracy, reasonableness), on formatting of data (transcription errors, reasonableness either on a facility or categorical basis), and on inventory assembly (completeness, reasonableness). The QA point and area source coordinator reviewed the Inventory Preparation Plan or IPP (MCESD, 2001), checked calculations, identified errors, performed completeness, reasonableness and accuracy checks.

Data collection procedures followed EPA guidance materials to assure inclusion in the inventory of all source categories. A listing of point sources was assembled from the existing point source inventory, and the county's inventory database. EMS (described in Section 2). Any questionable data were verified by telephone, fax or e-mail. Examples of data collection and data verification are included in Appendix 2-1.

Data quality was evaluated using several approaches. Data were cross-checked where multiple sources were available, and activity level based data were given preference. All calculations were reviewed for method and consistency, and those calculations done in spreadsheets were recalculated with a calculator or by hand as an error checking procedure. Examples of these recalculations are included in Appendix 2-1.

MCESD made necessary corrections to the inventory as errors were revealed through its own QA procedures and as recommended by other agencies. As a final check before the inventory was considered complete, MCESD staff completed the electronic inventory review checklists (see Appendix 7-1). These checklists cover a Level I and Level II checks (EPA, August 1992). During this final review, staff discovered only minor areas that needed attention. Data handling and reporting essentially is a reflection of EPA guidance documents and data reporting requirements. External comments made while reviewing the draft document are included in Appendix 7-2.

7.5 Review and Evaluation of Inventory Elements

7.5.1 General Statement

The general plan of the quality assurance program is described in the IPP (MCESD, 2001). Formal training sessions for inventory personnel were provided by EPA training workshops, as available. Informal training sessions for MCESD inventory staff were held as further EPA guidance became available. Topics covered in these sessions included:

1. Contents of existing and new EPA emissions inventory-related guidance or policy.
2. New or updated data sources or procedures for determining emissions estimates.
3. National Emission Inventory/ NIF training.
4. MCESD policy and standard operating procedures.

New personnel received briefings from their respective supervisors. However, most of their training regarding the details of their duties was received while on the job. Training materials (e.g., books and manuals) were available to familiarize new personnel with inventory work.

7.5.2 Point Sources

Two environmental planners checked inventory accuracy, reasonableness and assured that all point sources had been identified and that the methodology applied to calculate emissions was appropriate and that the calculations were correct. Other reasonableness checks were conducted by recalculating emissions by using methods other than those used to make the initial emissions calculations and then by comparing results. A quality assurance check of EMS was made on all SCC codes and Tier codes for determining the appropriate categories for facility's emission units. Quality Analysis (QA) was conducted by checking all emissions reports submitted to MCESD for the year 1999 for missing and questionable data and by checking the accuracy and reasonableness of all emissions calculations made for such reports. Notes concerning follow-up calls and corrections to calculations were documented on each 1999 annual emissions report.

Data entry for the NEI will be verified against the original hardcopy files for completeness and reasonableness. Since some data sources are more reliable than others, it is important that the reliability of the data be taken into account. For this reason, MCESD assessed all data against the capabilities and biases (if any, and if known) of the organization supplying the data, the techniques used to collect the data (if known), and the purpose for which the data were compiled. This assessment allowed MCESD to understand the limitation of the data and to choose the best data for developing emissions estimates.

Inconsistencies were located in the data presentation (i.e. different totals in tables) and were then corrected. General corrections to format were made including heading consistencies. Text was added to clarify how peak ozone season daily emissions were calculated. A table comparing past inventories emissions with emissions in 1999 was added. Text was also added to clarify that all point sources were re-inventoried and to outline the criteria for a facility to be included as a point source.

7.5.3 Area Sources

In creating the area source emissions inventory, two environmental planners checked data and calculations for accuracy, completeness and reasonableness and then reviewed the methodology, and rechecked completeness, reasonableness, and a sample of the calculations. A new format of categorizing emissions was created and the incorporation was double-checked. All miscalculations were corrected and then rechecked. All issues were discussed. A number of format changes were made in presenting the data in tables along with explaining calculations and changes in methodology.

The external reviewer checked accuracy in methodology based on the Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I (EPA, 1991) document. It was verified that all source categories listed in the Emission Inventory Requirements for Ozone State Implementation Plans (EPA, March 1991) document were included. Reasonableness checks were performed by recalculating emissions using alternate methodologies and by comparing results and/or analyzing totals and inputs to determine reasonableness.

Significant figures inconsistencies were located in the data presentation and were corrected. Example calculations were added to each section for clarity. There were a few instances where emission estimates in a table

were inconsistent with the text or were in error. For the "other" categories, where sources that didn't fall into those categories already presented were added, this values and facilities were rechecked to ensure that they weren't counted for elsewhere. General corrections to format were made including references to conversations via telephone.

7.5.3.1 Stationary Area Sources: Fuel Combustion

Input data in this source category are of high quality and verifiable by independent calculation. Within Maricopa County, natural gas is the principal fuel burned. Quantities of natural gas distributed to sub-categories (e.g. Electric Utilities, Industrial, etc.) were obtained from four sources and were found to be in good agreement. For residential natural gas combustion, emission factors for CO and NO_x had SCC codes inconsistent with those emission factors used in the CO inventory, so they were replaced.

7.5.3.2 Stationary Area Sources: Other Combustion

This category combined several miscellaneous sources, many with roughly estimated emission factors, and mainly those for fireplace, stove and firepit emissions. Qualitative dimensional assumptions and gross estimates of the quantities of materials burned were made. However, these reported quantities are so large, and their calculated contributions to the CO emission inventory of area sources are so significant, that they may overwhelm the more substantiated emission values of other sources. Due to the fire burning ordinance in Maricopa County and the limitation on building wood-burning fireplaces in new homes, MCESD decided to use 1996 estimated number of fireplaces to reflect a more accurate amount of firewood burned in fireplaces used. Additionally, a reviewer found an error in the calculation of wood density used, which was corrected.

7.5.4 Nonroad Mobile Sources

The quality assurance process for 1999 aircraft and locomotive VOC, NOx, and CO emissions was conducted by two environmental planners validating input data and performing calculations and reasonableness checks on the data. This was followed by an external reviewer's check on the section. The QA coordinator checked for accuracy, reasonableness, completeness of emission sources, and logical methodology based on chapters five and six of the EPA Emission Inventory Preparation Document (EPA, 1992). Several formatting inconsistencies were found and corrected. Errors were discovered in the calculations for two of the airports. General corrections to format were made including references to specific appendices.

For the nonroad emission estimates, seasonal changes were made based on data from the California Air Resources Board (CARB). This change was made because the assumptions used in NEVES for this category were considered inappropriate for this area and the limited data available more closely resemble the seasonal percentages used by CARB. More documentation was added to this section to adequately explain how the NEVES data was manipulated, including sample calculations. For the aircraft emissions, a reviewer found a discrepancy in their report of operations at Luke Air Force Base and what was reported in the inventory. Upon further scrutiny, the inventory was determined to be incorrect and the actual operations were included. Additionally, the VOC and NO_x emission factors were incorrect for Deer Valley airport emission estimates. The CO emission factor was accidentally carried over as the VOC and NO_x emission factors, which was corrected. These changes of course changed the emission estimations for the two airports, and the nonroad mobile emission totals.

7.5.5 Onroad Mobile Sources

See Section 5.7 of the ozone inventory for the quality assurance narrative regarding this category.

7.5.6 Biogenic Sources

The draft biogenic source portion of the 1999 periodic ozone inventory was reviewed using published EPA quality assurance review guidelines for base year emission inventories (EPA Document 450/4-92-007, August 1992). Additionally, the entire biogenic source portion of the 1999 periodic ozone inventory was reviewed by MAG staff that did not directly participate in its development. All comments were addressed.

7.6 Summary Statement

The accuracy of this inventory is a measure of the quality of our knowledge of the day-to-day, seasonal and annual statistics of emissions sources in the Maricopa County nonattainment area. Although effort was made to ensure that the data expressed in this inventory accurately represents the emissions in the nonattainment area in 1999, all components of the inventory, taken together, are subject to continued improvement.

The degree to which we are able to improve the quantity and accuracy of source data will determine the quality and reliability of future inventories. Efforts will be focused on obtaining valid and reliable information as well as improving emission calculation methods for future inventories.

7.7 References for Section 7

Maricopa County Environmental Services Department. Inventory Preparation Plan: Ozone. April 2001.

U. S. Environmental Protection Agency. Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Vol. I. EPA-450/4-91-016. May 1991.

U. S. Environmental Protection Agency. Emission Inventory Requirements for Ozone State Implementation Plans. EPA-450/4-88-019. March 1991.

U. S. Environmental Protection Agency. Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources. EPA-450/4-81-026d (Revised), Chapters 5 and 6. Office of Mobile Sources. Ann Arbor, MI. 1992.

U. S. Environmental Protection Agency. Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Vol. III: Emission Inventory Requirements for Photochemical Air Quality Simulation Models, EPA-450/4-91-014. May, 1991. LeadSource, Metro Phoenix, 1989-1990.

U. S. Environmental Protection Agency. Guidance for the Preparation of Quality Assurance Plans for Ozone/Carbon Monoxide SIP Emission Inventories. EPA-450/4-88-023.

U. S. Environmental Protection Agency. Quality Review Guidelines for 1990 Base Year Emissions Inventories, EPA-450/4-91-022. August 1992.